



UNIVERSITETET I AGDER

Citizens' Willingness to Adopt Digital Contact Tracing Applications

Findings from a mixed methods study in Norway

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*“The more people who download Smittestopp,
the faster we can have our freedom back.”*

- Erna Solberg, 2020,
Prime Minister of Norway.

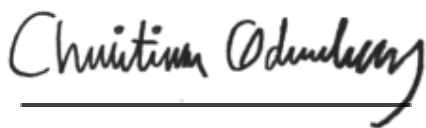
Foreword

This master's thesis was developed by two students during the final semester of the master's degree in Information Systems at the University of Agder in 2022. We had previously worked together in two courses during the penultimate semester, which laid the foundation for this thesis.

By studying information systems, we steadily developed an interest in how technology, people and processes work together and affect each other. It did not take long before we both agreed to investigate the human aspect of information systems.

We decided early on that we wanted to research how humans perceived their personal data when utilizing digital services. This growing fascination led us to explore different contexts to which sharing personal data occurs. Our supervisor recommended us to respond to a call of research on COVID-19 related papers. This eventually led to research on digital contact tracing applications, and how citizens in Norway perceived the official governmental application based on their privacy concerns and human emotions. By performing a mixed methods study on citizens' willingness to adopt digital contact tracing applications, we pave the way for future digital solutions by highlighting the flaws of previous attempts. We genuinely envision that this research can contribute to meaningful knowledge ahead of time for future major crises.

Being allowed to work on this thesis has given us valuable knowledge and experiences in every step of the way. We would like to thank our friends, families and fellow students for their endless support. A special thanks to everyone who contributed to our research through the questionnaire and follow-up interviews, providing us with meaningful data. We especially want to thank our supervisor, Ilias Pappas, who provided immense help and encouragement throughout the whole semester. He never hesitated to give us constructive feedback, and we would have been thoroughly perplexed without his guidance.



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Abstract

Context: Early 2020, the SARS-CoV-2 (COVID-19) pandemic began to spread globally. Digital contact tracing (DCT) applications began development soon after to help mitigate the spread and contain this major crisis. In Norway, the application Smittestopp was developed to fulfill the role as a digital solution. With a poor launch and little enforcement, less than half of the population downloaded the application. This experience should be explored further by the Norwegian government, in order to ensure successful digital solutions in the future.

Purpose: The purpose of this thesis is to explore Norwegians citizens' willingness to adopt Smittestopp, and if privacy concerns and human emotions affected these intentions. The way we measured this was by looking at how; 1) privacy concerns, risk beliefs, trusting beliefs and relative advantage impacts intention to use Smittestopp and 2) if human emotions moderate the effects of these relations, thus, impacting intention to use Smittestopp.

Methods: Our mixed methods research consisted of expanding an existing literature review and conducting a quantitative survey with a questionnaire. To complement the questionnaire data, follow-up interviews were also conducted. The literature review served as a theoretical foundation for our research, providing an overview of existing research on DCT-applications. A research model was adopted from a previous study examining Australian citizens' willingness to adopt the COVIDSafe-app. 9 hypotheses were developed to test suggested construct relations. The questionnaire was developed in SurveyXact by adopting questions from the aforementioned research paper, adjusting it for our research with the inclusion of human emotions. We received 189 valid responses to the distributed questionnaire, and made an interview guide aiming to complement and verify these responses further. We performed interviews with 11 volunteers from the questionnaire. The questionnaire data was analyzed using partial least squares structural equation modeling (PLS-SEM) in SmartPLS. The interview transcripts were analyzed using Quirkos; a Computer-assisted Qualitative Data Analysis Software (CAQDAS).

Results: All 9 hypotheses were validated and supported through an analysis of the questionnaire data. These findings were later complemented by interview data, which verified most of the hypotheses but also brought interesting and contradictory results. Most notably, relative advantage significantly increased intention to use. Also, privacy concerns increased risk beliefs, trusting beliefs decreased risk beliefs, and intention to use increased actual use.

Conclusion: We concluded that privacy concerns, trusting beliefs, risk beliefs and relative advantage affected citizens' intentions to use DCT-applications. Emotions moderate both relative advantage and risk beliefs relations into intention to use. The findings explain why Smittestopp was barely used, and how future digital solutions can learn from this.

Keywords: Digital contact tracing, COVID-19, information privacy concerns, trusting and risk beliefs, relative advantage, human emotions, Smittestopp, e-governance, mixed methods.

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Acronyms

API	Application Programming Interface
AVE	Average Variance Extracted
AWAR	Concept of awareness
BLE	Bluetooth Low Energy
CA	Cronbach's Alpha
CAQDAS	Computer-assisted Qualitative Data Analysis Software
CFIP	Concern For Information Privacy
COL	Concept of personal information collection
CON	Concept of personal information control
CR	Composite reliability
CSV	Comma-separated values
DCT	Digital Contact Tracing
DOI	Diffusion of Innovation
FHI	Folkehelseinstituttet (The Norwegian Institute of Public Health)
GAEN	Google & Apple Exposure Notification
GDPR	General Data Protection Regulation
GPS	Global Positioning System
H1-H9	Hypothesis 1-9
IS	Information System
IT	Information Technology
ITU	Intention to Use
IUIPC	Internet Users' Information Privacy Concerns
LVS	Latent Variable Score
MAST	Model of Assessment of Telemedicine
NSD	Norwegian Center for Research Data
PC	Personal Computer
PLS-SEM	Partial Least Squares Structural Equation Modeling
R	Concept of risk
RA	Concept of relative advantage
RQ(s)	Research Question(s)
SARS-CoV-2	Severe Acute Respiratory Syndrome Coronavirus 2
SD	Standard Deviation
SMS	Short Message Service
SPSS	Statistical Package for the Social Sciences
T	Concept of trust
UIA	University of Agder
UIO	University of Oslo
URT	Uncertainty Reduction Theory
UTAUT	Unified Theory of Acceptance and Use of Technology

1. Introduction

This thesis was written with a focus on topics that are a culmination of information technology (IT), information systems (IS) and motivational factors of the human psyche. More specifically, thoughts and opinions concerning privacy, trusting and risk beliefs towards digital services and digital solutions.

The use of IT and IS have been growing steadily and rapidly. Together with the internet and social media, information and technology has been a huge part of the average human's daily life for some years. Gadgets like PCs and smartphones are tightly embedded in personal lives, work environments and schools across the globe. Most notably, the smartphone has been an important asset and almost a necessity in human life the last couple of years (Lee et al., 2014). Smartphones provide easy access to an increasing amount of services, all in one place in your pocket. This increase of location data and information spread has caused debates regarding privacy and trust, and discussions concerning the boundaries of acceptable personal information collection (Graeff & Harmon, 2002).

No matter what website you are visiting or application you are using, you are given the right to privacy and data protection. However, billions of users are giving their consent to share personal data to benefit an online business model without acknowledging this themselves (Jørgensen & Desai, 2017).

While most data collection is being used to tailor user experiences for the better, this decrease of users' information control also shows that the technology itself comes at the cost of both risk and vulnerabilities (Menard & Bott, 2018). During the COVID-19 pandemic, it became more prevalent that online privacy concerns have affected some peoples' intention to use certain digital services, reducing their willingness to share personal information. This can be seen when investigating users' intentions to adopt digital contact tracing (DCT) applications, where some choose to neglect use due to privacy concerns and lack of awareness, instead of benefiting the greater good (Lin et al., 2021).

1.1 Research area

To narrow this research area into a more specific topic of concern, we chose to focus on how COVID-19 has affected peoples' intention to use online applications and services. The main reference point for this research is the Norwegian contact tracing application 'Smittestopp', developed by the Norwegian government. We wanted to see how and why people have been persuaded into using this application. Also, we aimed to find those who neglected it completely, exploring reasons for why they rejected the app. Ever since COVID-19 was declared a pandemic in March 2020, we believe restrictions and lockdowns have made people more exposed to technology in their own homes, thus, more aware of their personal data. This has increased the digital divide amongst those who do not have access to technology, and in many places these circumstances of the pandemic are still continuous (Vargo et al., 2021).

1.2 Research gap

Digital contact tracing (DCT) is a technology utilized by many countries and states, and has been an important asset in the fight against the COVID-19 virus (Sun & Viboud, 2020). Governments and private organizations across the world have tried to develop DCT-applications as a public health practice in order to track, identify and notify victims of the COVID-19 disease (Martin et al., 2020). However, many different solutions have been proposed, and these vary in efficiency, privacy and data collection implications (Riemer et al., 2020). Furthermore, an extensive study has been conducted on Australia's own DCT-solution, the COVIDSafe-app, focusing on the citizens willingness to adopt the application and share personal information (Lin et al., 2021).

The Australian application, COVIDSafe, has raised privacy concerns amongst its national citizens, even as the application (and other government DCT-apps) enforce personal information and privacy protection (Lin et al., 2021). Lin et al. addressed the importance of this emerging research area, and that a call for research is warranted as there is a significant research gap. Not for the Australian application specifically, but on a global level. As a response to this, this thesis has incorporated Smittestopp as an asset to ascertain Norwegians willingness to adopt DCT-applications, drawing parallels to other digital services as well.

1.3 Motivation for research

Mitigating major global or national crises is a constant battle of preparation and learning. A major crisis usually hits before one has time to react, and as such, learning from similar events from the past is crucial (Moynihan, 2009). A pandemic poses a major threat to the society as a whole. While developing a cure and distributing publicly is a main goal of such crises, mitigating spread and contact needs to be continuously done beforehand (Koo et al., 2020). Technology is used in many ways to help in major crises like this. Technology that distributes warnings and trace spread of viral diseases are a few examples. Researching and developing the right tools make us more prepared to face such events. Lin et al. (2021) addressed the need for research on contact tracing applications and its impact on willingness to utilize them, stating: “It is important for future research to expand on this study and explore privacy attitudes for contact tracing in different countries to document global perspectives.” (Lin et al., 2021, p. 397). We answered by adapting their theory model, IUIPC (Internet Users’ Information Privacy Concerns), in conjunction with Smittestopp in Norway.

As of writing this thesis, most of the restrictions imposed and recommended by the Norwegian government have been lifted, and thus, the country is attempting to cope with COVID-19. Therefore, social distancing, lockdown and compulsory use of face masks in public space is considered a thing of the past. However, the virus has been shown to mutate over time into more contagious variants of itself, creating new waves of the pandemic disease (Zawbaa et al., 2022). Though Norway and other countries are now more experienced in handling the pandemic, it is important to look back at previous instances and evaluate the effectiveness of measures taken to prevent the disease, as new waves are to be expected (Osuchowski et al., 2020). As there is currently lack of research regarding privacy and trust beliefs in digital services during and after COVID-19 (Prakash & Das, 2022), this paper aims to contribute to relevant research for future studies.

1.4 Research questions and approach

In order to conduct a research study with a clear goal, we needed two research questions (RQs). Answering these RQs would be the goal in every aspect of this research study, and thus, we had to apply a suitable research method. This research method approach would ensure that we would not stray away from answering the two RQs.

1.4.1 Research questions

As previously stated, there is currently lack of research regarding privacy and trust beliefs in online and governmental services after COVID-19 (Prakash & Das, 2022). Thus, we draw from existing studies and the Internet Users' Information Privacy Concerns (IUIPC) model. This is done to examine the adoption of the Smittestopp application in Norway. Hence, we therefore propose the following RQs for this research study and master's thesis:

“How do privacy concerns, trusting beliefs and relative advantage affect citizens' willingness to adopt contact tracing applications?”

and

“How do human emotions moderate citizens' willingness to adopt contact tracing applications?”

As our study draws from existing research, the first RQ is borrowed from Lin et al. (2021), albeit slightly modified. We deliberately chose to focus on the constructs of privacy concerns (which consists of awareness, control and collection), trust and risk beliefs and relative advantage. However, we did not adopt some constructs like compatibility and perceived ease of use (diffusions of innovation). This was done to keep the scope of the research manageable within the given timeframe, and make room for our other included RQ. Human emotions was a new addition to this existing model (Pappas et al., 2016), as we believed that the feelings of individuals would impact whether citizens would adopt contact tracing applications. Past studies show the importance of emotions when it comes to privacy and sharing information online for personalized services and online shopping (Pappas et al., 2013; Pappas, 2018).

1.4.2 Research approach

To address our two RQs, we chose to collect empirical data from Norwegian citizens. We wanted insight from both DCT-adopters and non-adopters in order to explore both positive and negative perceptions on DCT. Our methodological approach to this study was a mixed methods approach, utilizing the benefits of both quantitative and qualitative research. As this research area is applicable to every Norwegian citizen living in the country since the pandemic started, we realized that we would aim to reach out to as many people as possible, as well as to gain sufficient in-depth thoughts from these people. Thus, we designed and developed a questionnaire on SurveyXact which, through several different social media and communication channels, received 189 valid responses. The questions of the questionnaire were rewritten and translated from Lin et al. (2021), in order to apply directly to Norwegian

citizens while also supplementing their existing theoretical framework and concepts. The analyzed data from these responses, aligned with the theory model from Lin et al. (2021), would go on to be developed into an interview guide for qualitative research. Some volunteers from the questionnaire showed interest in participating in a follow-up interview, eventually leading to an interview sampling of 11 individuals whom we garnered valuable insight from. Thus, we combined our survey questionnaire and follow-up interviews into a mixed methods study, showcasing citizens' perceptions on contact-tracing applications (Smittestopp), and willingness to share personal data to a digital government.

1.5 Structure of the thesis report

The structure of this thesis was designed consciously, as we aimed to give the readers a sense of natural progression throughout the study. After this introduction, chapter 2 focuses on highlighting the context of our research. These are topics such COVID-19, Smittestopp and personal data, which our research fundamentally revolves around. Chapter 3 follows by introducing theoretical background concepts and a related literature on these topics. After presenting our contribution to existing literature review, we present the theory constructs one-by-one. These constructs are part of a research model with corresponding hypotheses, which we further elaborate on as the focus of chapter 4. Chapter 5 revolves around our research approach. As we went for a mixed methods approach, we spent a good amount of time evaluating both quantitative and qualitative approaches, and how these approaches were to be analyzed. The findings of both the analyzed questionnaire responses and our semi-structured interviews are presented in chapter 6, including tables showing path coefficients and tested hypotheses. We have, in chapter 7, discussed these aforementioned findings and results up against existing literature presented from chapter 3. We discussed our hypotheses and answered our research questions here as well. Additionally, we investigated how these findings can have implications for future research and practices. We have also been self-critical and noted some limitations and shortcomings of the study, and come up with suggestions on how these could have been avoided. Lastly, the conclusion of the thesis concludes the study as a whole, highlighting the significant results and ascertaining the importance of the thesis for future research. References and appendices used in developing this thesis are attached at the end.

2. Context for Research

In order to grasp the study we have conducted, one needs to have prior knowledge of what transpired throughout the world since early 2020, and on how Norway as a nation dealt with these circumstances. This chapter was made to give context to later theory and literature, and to give the reader a full picture of the scope of the study. Many might regard the following topics of this chapter as ‘common knowledge’, however, we chose to include it as a refresher in order to introduce the theoretical concepts, as they expand on this knowledge. As with the thesis as a whole, we introduced the following topics in a consistent manner that feels natural from beginning to end, transitioning into the literature and research constructs of chapter 3.

2.1 COVID-19 pandemic

In late 2019, an outbreak of an infectious pneumonia started to spread from Wuhan in China. This severe acute respiratory syndrome, SARS-CoV-2, was a coronavirus (called COVID-19) that would later claim the lives of millions of people, and after a rapid global spread was declared a pandemic on March 12th 2020 (Ciotti et al., 2020). The disease is known to be easily transmittable between humans, and usual symptoms often include fever, cough, sore throat, breathlessness, fatigue, or no symptoms at all (Ahmad et al., 2020). Also, the disease was said to have a reasonably high fatality rate of 2% during its earlier expansion, and could be cured through general treatment, symptomatic treatment, by using antiviral drugs, oxygen therapy and by the immune system (Ahmad et al., 2020).

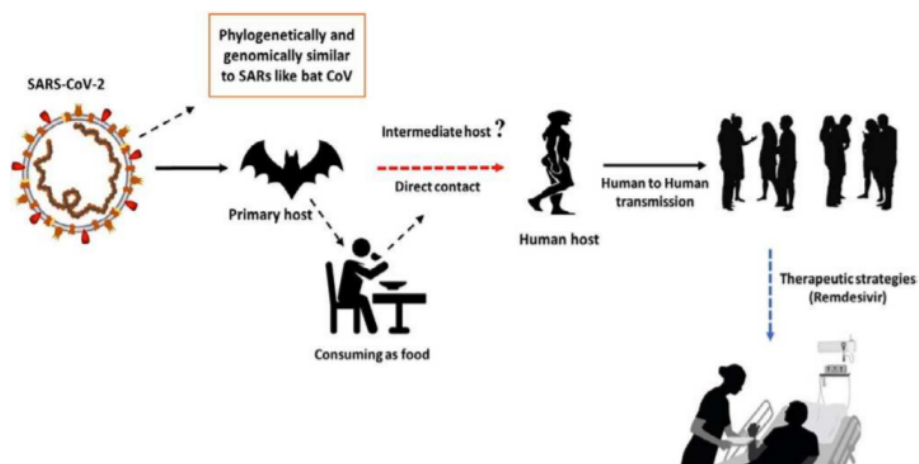


Figure 1 - The transmission of COVID-19 to the human host (Ahmad et al., 2020, p. 118), implying the importance of social distancing.

2.1.1 Global influence

Towards the end of March 2020, most countries started taking immediate action and precautionary measures to reduce the spread of COVID-19. Arguably, the initial containment of the virus was considered insufficient and delayed, and the countries having direct connections with China were quickly affected (Osuchowski et al., 2020). As a result of this, the affected countries started to propose harsh and restrictive mitigation mechanisms in an attempt to reduce the spread, including social distancing, lockdown, closing of country borders and curfew. This led to over 250 million Europeans having confined themselves to lockdown as of March 18th 2020, only 6 days after it was declared a pandemic (Osuchowski et al., 2020). On an international scale, many hospitals and healthcare facilities suffered immensely both financially and socially, not meeting the required amount of staff and resources to treat the onstream of patients (Kaye et al., 2021). However, international medical progress has been made, and as of May 25th 2022, 11.79 billion vaccine doses have been administered globally, where 65,8% of the world population has received at least 1 dose of COVID-19 vaccine (Our World in Data, 2022). However, as of writing this thesis, the COVID-19 is still considered a pandemic, and most countries persist to fight the ongoing infection spread.

2.1.2 Influence in Norway

As with most other European countries, Norway initiated preventive measures and restrictions early in order to maintain the spread at a reasonable pace. A significant day in their response to COVID-19 is March 12th, where Norway's prime minister at the time, Erna Solberg, introduced the strictest restrictions and most invasive legislations in 70 years, where the main measures were as follows:

- “Advice on frequent washing of hands, keep social distancing and limit gatherings to a maximum of five people. Quarantine those who are infected, secure hospital capacity and increase authority to track contagion.
- Avoid unnecessary journeys and public transport. All Norwegians must quarantine for 14 days when returning from abroad. Stricter border controls and closed for foreigners.
- Mandatory closure of kindergartens, schools, universities and colleges, as well as training facilities and competitions in sports and cultural events.

- Mandatory closure of hairdressers and hotels.
- People were not allowed to stay overnight in other homes or cabins in another municipality.
- Some local governments reduced access to certain geographic areas.”

(Christensen & Lægreid, 2020, p. 775)

The Norwegian Institute of Public Health (FHI) started early with development of a contact tracing application in order to circumvent COVID-19 spread. The application is called Smittestopp (‘infection stop’), and was designed as a specific technofix for the Norwegian government, aiming to reduce social encounters within the population by warning smartphone users of virus encounters (Sandvik, 2020).

2.2 Contact tracing and digital solutions

Since the start of the pandemic, digital contact tracing provided a comprehensive way to collect and analyze data on people’s proximity, movement, location and health status, and has been used by many countries as a main technofix to the COVID-19 situation (Grekousis & Liu, 2021). The premise of contact tracing is simple; public health organizations in countries develop applications where a diagnosed user can upload their positive test, giving out warning notifications to each user that this person has been in close proximity to. This process is in most cases done manually by identifying the infected people, then obtaining information about people whom they have had close contact with while being infected. This is followed by identifying and quarantining all of these contacts to hinder further spread of the coronavirus (Prakash & Das, 2022). Digital contact tracing can differ based on the technology used, e.g. “location-based services, geospatial technologies, proximity awareness technology, machine learning algorithms, and automated decision making to scrutinize individual’s digital footprint and trace those who are potentially infected, locate their close contacts and enforce specific health protocols or social distancing” (Grekousis & Liu, 2021, p. 2).

2.2.1 European DCT-applications

Most countries in Europe have developed a contact tracing application to counter infection spread, with the most prominent ones as being presented by Martin et al. (2020).

Table 1 - Some European DCT-applications with at least 100.000 downloads, as of September 2020 (Martin et al., 2020).

Country	Name of application
Austria	Stopp Corona
Czech Republic	eRouska
Denmark	Smittestop
Finland	Koronavilkku
France	StoppCovid
Germany	Corona-Warn-App
Ireland	COVID Tracker
Italy	Immuni
Latvia	Apturi Covid
Netherlands	CoronaMelder
Norway	Smittestopp
Poland	ProteGO
Portugal	StayAway Covid
Spain	RadarCOVID
Switzerland	SwissCovid

After the initial outbreak, several countries rushed to utilize surveillance and monitoring mechanisms and systems, focusing on alerting individuals by notifications using Bluetooth-technology (Bluetooth Low-Energy/BLE) in user smartphones (Martin et al., 2020). Moreover, many of these countries use Google/Apples Exposure Notification API framework (GAEN) in order to notify its users, and is known for its privacy-preserving decentralized approach by storing most of the data locally for its users (Leith & Farrell, 2021).

Findings from Leith & Farrell (2021) suggest that many public health authorities are well-behaved and concerned about privacy when developing these applications, but that the Google Play Services components in GAEN are problematic due to its contact with Google servers. The newest iteration of Smittestopp is also built on the GAEN framework (Lintvedt, 2021), as a response to the controversial privacy concerns of the first iteration.

2.3 Smittestopp

The Smittestopp-application we have, as of writing this study, has been through a few iterations and a lot of changes, and is now officially referred to as Smittestopp 3.0 (Folkehelseinstituttet, 2022). Since its initial release, it has been available on Google Play for

Android users, and likewise App Store for iOS users, and has had a 16 year old age limit since.

2.3.1 First iteration

The first iteration of Smittestopp was launched as early as April 16th 2020, after a relatively rushed development by FHI (Lintvedt, 2021). This iteration of Smittestopp used both Bluetooth and Global Positioning System (GPS) technology, in contrast to most other contact tracing applications and the newest iteration of Smittestopp, which primarily only use Bluetooth. As described by Martin et al. (2020): “When two users are physically close, the smartphones send their ID to each other and record via Bluetooth the time of the encounter, its duration, and the ID of the other user”, further explained by: “For more accurate positioning, the app will also record GPS coordinates. The details of the encounters logged by a smartphone along with the corresponding GPS data are sent continuously to the central server. In case of infection, a user signals it within the app, and the encountered users will receive a SMS notification of the situation” (Martin et al., 2020, p. 23). The application would store personal data centrally for a limited time, with GPS data being stored for 30 days for contact tracing purposes before deletion (Lintvedt, 2021). Along with GPS data, this iteration of Smittestopp also stored operating system numbers, phone models and details of registered encounters. FHI stored any data about users’ movement anonymously, and was only accessed by authorized personnel of FHI (Martin et al., 2020).

Centralized data storage, along with location based data, was considered a large-scale surveillance and monitoring of the Norwegian population, and garnered a lot of criticism in the nation, but quickly reached 1,5 million downloads nonetheless (Lintvedt, 2021). On the launch of Smittestopp, prime minister Erna Solberg said publicly that “The more people who download Smittestopp, the faster we can have our freedom back”, a phrase met with criticism due to the neglect of the privacy concerns included in the application, initially asking the public to sacrifice freedom and privacy for *perceived* freedom (Sandvik, 2020). The first version of Smittestopp was deactivated on June 16th 2020 due to the rising privacy concerns and lack of transparency for citizens (Martin et al., 2020), and other concerns regarding user friendliness, downloading errors and high battery use even when the application was not actively being used (Sandvik, 2020).

2.3.2 Second iteration

The Ministry of Health and Care Services in Norway released a second version of the application on December 21st 2020, which essentially was a whole new application under the same name 'Smittestopp', built on the GAEN-framework and Danish' source code from Denmark's 'Smittestop'-app (Lintvedt, 2021). The focus of this iteration of Smittestopp was decentralization and protection of personal privacy, removing the GPS-technology previously used, only relying on Bluetooth and storing of data locally. The development process was considered open, with external developers and activists being invited to the project, and the source code being available publicly on GitHub (Lintvedt, 2021). FHI themselves rendered this approach as a brand new technological solution, and emphasized that despite the identical name, these two iterations had almost nothing in common (Folkehelseinstituttet, 2022). On the official page about Smittestopp (Folkehelseinstituttet, 2022), the Norwegian Institute of Public Health reassure the following points:

- The new application stores all data locally, and does not upload to a central storage like the old version did.
- The new application uses only Bluetooth, not GPS or other kinds of satellite tracing.
- The new application does not store location data, and where you have been.
- The new application is only used for contact tracing, not analyses or research.
- The new application does not collect data where you can identify, which means that you can get no insight on anyone from it.
- The new application does not automatically notify others, that feature is accessible for the user in case they want to, and when they want to.

Norwegians have always been encouraged to use the application, whether it being the older version or the reimagined one. However, it has always been voluntary for the citizens and not required by law. The user has always had the final say, by having to give their consent to the usage of contact tracing technologies in Smittestopp, whether it being the Bluetooth or GPS-location based mechanisms in the first iteration. In the span between Desember 2020 and October 2021, the new application had been downloaded just over 1 million times (Lintvedt, 2021). We believe that the stagnated amount of downloads from this version and the first, is due to the lack of trust in the application and FHI, stemming from the controversies surrounding the first version. This, together with the lack of visible effect by using said

application. The first iteration of Smittestopp raised concern for being harmful, while the second iteration was criticized for being both harmless and useless (Lintvedt, 2021, p. 69).

2.3.3 Third and current iteration

The third version of Smittestopp, formally called ‘Smittestopp 3.0’, was released in June 2021 by Netcompany, who had been working closely with FHI on optimizing the application (Mauroy et al., 2021). The differences between the second and third iterations of Smittestopp are not as drastic as the transition from the first to second. The main upgrades and focus points of this iteration were optimizations done to the contact detection technology (Folkehelseinstituttet, 2022) and a feature that makes the application more adjustable to criteria set by the health authorities (Mauroy et al., 2021). According to FHI, collaborated tests with Netcompany from the pre-release of 3.0 showed that 93% of all close contacts of infected individuals was being caught up by this new iteration of Smittestopp, deeming it an effective upgrade (Folkehelseinstituttet, 2022). As a response to the lack of transparency in the first iteration of Smittestopp, each user has to navigate through an intro sequence the first time they open the app, which formulates the intentions of the Smittestopp, and how technology and privacy is handled.

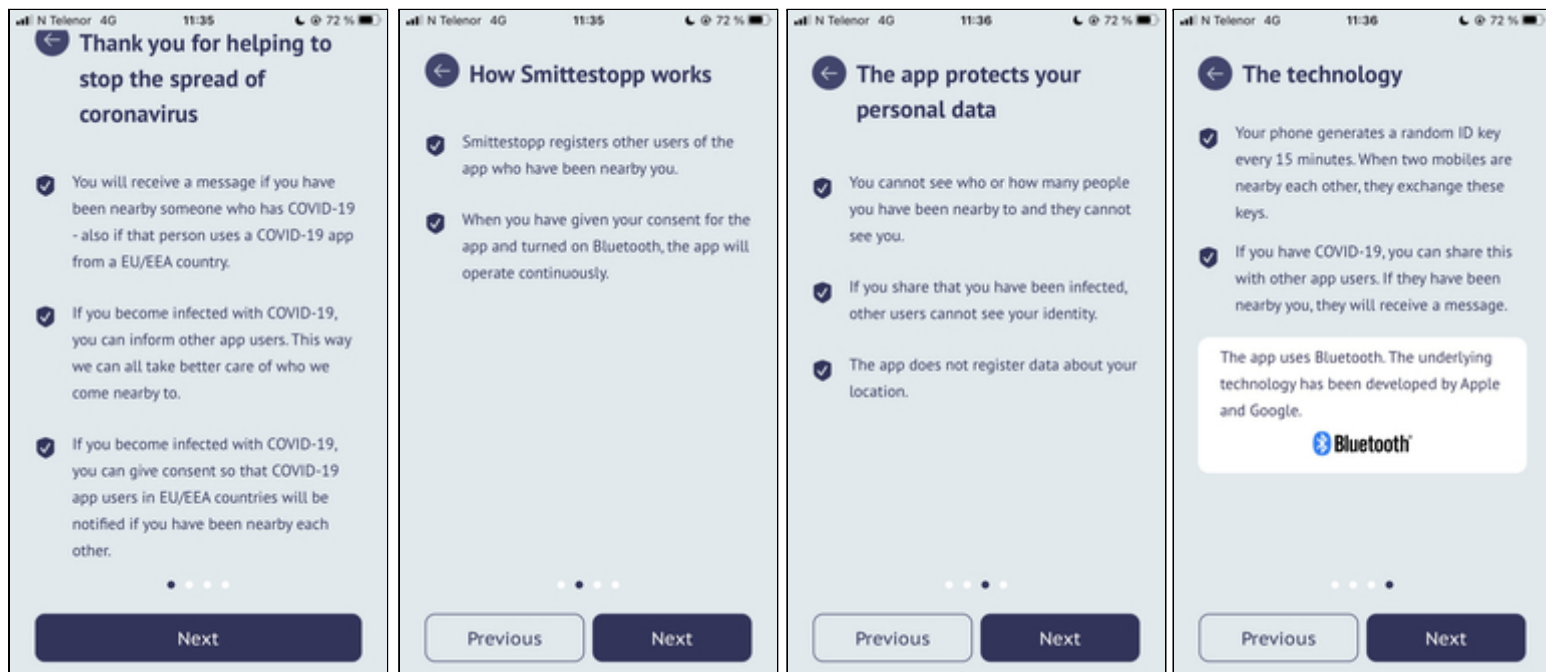


Figure 2 - Screenshots of the introduction prompt when opening Smittestopp for the first time, captured on our own smartphones (2022).

As COVID-19 decreased in infection rate, and more citizens got vaccinated,, Norwegians are no longer encouraged to use the Smittestopp-application by FHI. However, they are still recommended to keep it in case of new waves of virus spread, and the app is still being maintained (Folkehelseinstituttet, 2022). This occurred simultaneously with the lifting of the remaining restrictions imposed by the Norwegian government on February 12th 2022. As of now, most Norwegians are back to the same lifestyle as pre-COVID, with the precautions and recommendations that entails infected people. Still, Smittestopp has been an integral part of the Norwegian government's attempt at reducing infection spread, giving more control to its citizens while constantly raising awareness around the application.



Figure 3 - The Smittestopp logo (Folkehelseinstituttet, 2022).

It has also been interesting to see the progress of the application, how it drastically changed and reinvented itself to become far less privacy-intrusive during its second iteration. Moreover, we believe that many Norwegians still think of Smittestopp as if it still is its first iteration, using GPS technology to track the movement of Norwegian citizens, creating a false scenario that is now irrelevant and untrue to the philosophy of the current application. This is something we aimed to uncover when the findings of our research are being discussed later in this thesis.

2.4 Personal data

The motive and methods of collecting personal data ranges differently between several platform manufacturers. Every day, consumers give up personal information to larger corporations in exchange for either free or inexpensive services or goods (Dobkin, 2018). These services include online platforms, social media, voice-controlled digital assistants, customer services, purchase histories, user profiles, mobile applications. Smittestopps first iteration, as previously mentioned, was controversial because of concerns regarding

misinformation and lack of transparency around personal data collection, causing it to undergo a complete overhaul (Lintvedt, 2021). How we address personal data and information is an integral part of this study.

2.4.1 Definition of personal data and GDPR

Throughout this thesis, we have mentioned the term ‘personal data’ extensively during our research. As personal data and information is a prominent part of our study, and something we constantly refer to when communicating with respondents and interviewees, we referred to an official definition; “Personal data is any information that could possibly identify any living individual, where different pieces of personal information ultimately lead to the identification of this particular individual” (European Commission, 2022). As long as a person can be identified, they fall within the scope of General Data Protection Regulation (GDPR), and all the policies this entails. According to the official regulations of the European GDPR (2016) and European Commission (2022), examples of personal data could be:

- Name or surname
- Home address
- Email address
- An identification card number
- Location information (for instance location based data on a mobile phone)
- Internet Protocol address (IP-address)
- Data held by a hospital or doctor

With technology growing and expanding exponentially, some people have expressed their concerns for trust and privacy related to personal data and how this is collected. As a result of this, the GDPR regulates personal data accordingly, and protects personal data regardless of the technology used for collecting and processing said data. Also, the manner of how the data is stored is not relevant, be it an IT-system, on paper, on video etc; in all cases, personal data in any form falls under the protection and policies of the GDPR (EU GDPR, 2016).



Figure 4 - Depiction of different aspects of GDPR, including the date of its enforcement to the public on 25th of May, 2018 (Image retrieved 01.04.22 from Snel (2018)).

On the topic of the previously described contact tracing applications, the European Commission issued guidance on the usage of said applications, advising countries to not use location-based technology, as it was not necessary to track the movement of citizens, and that this would only lead to security and privacy issues (Lintvedt, 2021). Smittestopp would later learn from this statement when releasing its second iteration.

Both in the quantitative part and qualitative part of our study, we mention online privacy policies and GDPR for our candidates. This is to explore the awareness and control of Norwegian citizens. This is also done to observe how they perceive the self-security they have while browsing through the internet and several apps that might be privacy intrusive.

2.4.2 Self-disclosure

Despite citizen concerns for privacy for personal data, willingness to self-disclose has been shown to fluctuate depending on the background and demographics of individuals (Choi et al., 2018), as online privacy is a global phenomenon. In 2015, several social media sites were analyzed in order to determine why users share their personal information, experiences and social support publicly (Oh & Syn, 2015). The researchers studied five different social media platforms based on ten motivational factors (enjoyment, self-efficacy, learning, personal gain, altruism, empathy, social engagement, community interest, reciprocity, and reputation), and discovered that these five platforms hugely differ in user motivation as they all vary in content and user experiences (Oh & Syn, 2015). Furthermore, some studies show that people have been willing to put aside risk and trust beliefs when willingness has been driven by monetary

gains and incentives, self-disclosing personal data for as little as 25 cents (Bansal & Nah, 2020).

On the other hand, some people are greatly concerned about privacy online, withholding personal information by neglecting an online presence. Depending on the digital platform, these privacy concerns could be advocated. However, some individuals foster negative assumptions towards a platform, creating false assumptions on the capabilities of the technology at hand. This very behavior ultimately caused a decline in usage of the Australian COVIDSafe-application, reducing the awareness of infection spread of COVID-19 in Australia (Lin et al., 2021), an application bearing many similarities to the Norwegian Smittestopp-app.

3. Theoretical Foundation

Chapter 3 and 4 serve as the two main theory chapters of the thesis. In this chapter, different concepts, terminologies, studies and background literature are introduced and described in order to support our research further. This chapter also supplements the highlights on the world situation and Smittestopp from chapter 2 with theoretical context for later discussion. This chapter, in particular, serves to uncover relevant theories used in this study's theory model by defining the different constructs used, step-by-step. We have also borrowed a literature review developed by Prakash & Das (2022) on contact tracing applications, and contributed to this by adding other relevant recent studies. Chapter 4 will continue the theory aspect of the study by showcasing the full research model, as well as developed hypotheses for research.

3.1 Literature Review

Our research area is neither exclusive nor limited to Norway alone, and thus, examples from other countries have been helpful material to supplement our own study. We have used Prakash & Das' (2022) literature review to garner a list of relevant literature from the past two years (2020-2022). We adapted a research model from Lin et al. (2021), which we found through the literature review. They declared a call for research on DCT- applications, and thus, we adjusted their research model to fit our Norwegian research. We have also contributed to this literature review by extending it with 6 recent studies, which are presented in 3.1.2. Lastly, we will discuss how this literature review was influential towards our thesis.

3.1.1 Findings from literature review

Prakash & Das (2022) motivation for studying citizens' resistance to use DCT-applications is appealing. While substantial investment in such applications are prominent across the world, the usage of these applications are phenomenally low (Prakash & Das, 2022). They claim that little is known to why people resist using these applications, as they are fundamentally developed as an innovation that can potentially save millions of lives worldwide when used properly and as intended. For their study, they went for a mixed methods approach, and reviewed 18 study reports related to DCT-applications in order to gain sufficient research to back up their own study on the topic. Their full literature review, including summaries, can be found in appendix A.

They found that many citizens choose to adopt DCT-apps due to perceived self-benefits, self-efficiency, self-societal benefits and social influence (Walrave et al., 2020; Trang et al., 2020; Fox et al., 2021). On the contrary, impediments to disrupt adoption of such applications were found to be concerns regarding security and privacy, lack of trust in government, inability to install apps/activate Bluetooth, protection of family and friends and risk beliefs (Altmann et al., 2020; Sharma et al., 2020; Blom et al., 2021, O’Callaghan et al., 2021; Hassandoust et al., 2021).

In a study conducted by Touzani et al. (2021), only 19,2% out of 1003 (193/1003) supported the usage of the DCT-application in France, while roughly half of them were reluctant (50,3%, 504/1003), with reluctance reasoned with financial deprivation, perceived usefulness, trust in political representatives and concerns about the pandemic situation and knowledge regarding COVID-19. In their previous study, Prakash et al. (2021) also found that user satisfaction, along with trust in technology and government, were major determinants of an individual's intention to both use and continuously use a DCT-application (Prakash et al., 2021). They followed up on this by explaining that user satisfaction itself is influenced by perceived security and privacy, as well as trust in technology.

One of the studies we found most interesting was the Australian study regarding privacy concerns and digital government (Lin et al., 2021), which explored Australians willingness to adopt their contact tracing application, COVIDSafe. Their study investigated a variety of different concepts, such as awareness, data collection, citizen control, risk beliefs, trust and privacy. They found that trusting beliefs, compatibility and relative advantage increased the chances of citizens adopting the application. Most users of COVIDSafe implied it was better to download the application than not, hence relative advantage. Our thesis has, with some alterations, adapted the theory model and survey questions from Lin et al. (2021), as we aimed to contribute to their call for research concerning this relatively recent research area.

3.1.2 Expanding the literature review

The 18 studies reviewed by Prakash & Das (2022) are all focusing on DCT in mobile applications, and explains the importance of these applications during the COVID-19 pandemic, calling it a ‘renewed interest’. Our study is centered around Norway, and while

none of these studies specifically revolve around Smittestopp, they research the same types of technologies and apply to our study nonetheless.

Our reasoning for adding this to the thesis was to add context and provide a list of studies that explain the importance of these types of studies. DCT-applications have, as mentioned, gotten a resurgence in attention and the technology has stigma built up around it (Prakash & Das, 2022). We thought it would be highly beneficial to have a dedicated section for showing what research has been done, in regards to what affects users' acceptance of DCT-applications.

This was not only helpful to us as researchers, but also as a reader of this thesis. Moreover, this expanded literature review serves as evidence that the study we undertake in this thesis is needed and should provide useful insights into the Norwegian perception of DCT.

3.1.3 Articles added to literature review

Table 2 showcases our contribution to Prakash & Das' literature review. 6 studies are presented and summarized in a similar fashion and format to that of the aforementioned researchers. Their original literature review can be found in [appendix A](#).

Table 2 - Our added material to Prakash & Das' (2022) [literature review](#).

Literature review

Author (year)	Objective/Context	Methodology	Theory	Results/Findings
Munzert et al. (2021)	To measure actual usage of a DCT and find differences in uptake among different groups as well as examining reasons for higher uptake.	Quantitative Survey, SEM	Randomized Intervention	Higher rates of uptake was revealed among respondents with increased risk of severe illness, but lower for those with a heightened risk of exposure to the disease. Informative and motivational video messages have very limited effect on uptake, but more findings suggest that small monetary incentives strongly increase uptake of DCT.
Garousi et al. (2022)	Identify main problems users report in regards to DCT apps and focus on the "software in society" aspects of the apps.	Qualitative review analytics tool	UTAUT	Users are generally dissatisfied with the apps that were studied, except for the Scottish app. Issues reported were mostly related to doubts that the DCT apps actually work and high battery consumption.
Oldeweme et al. (2021)	To investigate how uncertainty reduction measures increase adoption of DCT apps and how their use affects perception of different risks.	Quantitative Survey	URT	Uncertainty reduction measures like transparency dimensions disclosure and accuracy, as well as trust in government and social influence, foster the adoption process. The use of DCT apps reduced the perceived privacy and performance risks, but did not reduce social risks and health related pandemic concerns.

Li et al. (2021)	To investigate the effects of app design choices and individual differences on DCT app adoption intentions.	Quantitative Survey	Privacy Calculus	Individual differences played a more important role than app design choices. Certain app designs could lead to inequality of acceptance from people. Analysis showed that one's perception of the public health benefits offered by the app and the adoption willingness of other people had a larger effect in explaining the observed effects of app design choices and individual differences than one's perception of the app's security and privacy risks.
Chen & Thio (2021)	To characterize DCT systems developed around the world and compare uptake rates with different technologies and more.	Qualitative Study	MAST framework	Drivers and barriers are found and discussed. Suggestions for policymakers are also made in regards to how to influence barriers and drivers in order to increase uptake.
Huang et al. (2022)	To assess factors influencing adoption and influence of DCT app.	Quantitative Survey	DOI	Perceived ease of use had higher likelihood of uptake and use, while concern about personal data lowered the likelihood. Social norms were also positively associated with uptake and use, but liberal individualism was negatively associated with uptake and use.

We aimed to contribute to their literature review by adding more recent studies to their 18 reviewed articles in order to strengthen their study, while also being highly beneficial for our research process. As seen summarized above, privacy concerns, uncertainty and trust in government were reasons that DCT-applications were not accepted by the general public (Oldeweme et al., 2021; Li et al., 2021), but other indications were also considered. Munzert et al. (2021) found that even the smallest amount of monetary incentives could strongly increase the uptake and usage of DCT-applications. These findings fell in line with results from Bansal & Nah (2020) on willingness to share personal data, highlighting that individuals concerned about privacy and trust would be willing to share personal information for a very small amount of monetary reward (Bansal & Nah, 2020).

Chen & Thio (2021) characterizes DCT-systems around the world, including several of the European applications we presented in [2.2.1](#), and suggests different policies in order to influence barriers and drivers to increase uptake of these systems. Furthermore, it seemed like differences in individuals had more impact on willingness to use DCT-applications, rather than the design choices behind the application itself (Li et al., 2021), although situational characteristics and demographics did not have a massive impact on application downloads according to Saw et al. (2021). In contrast, Li et al. (2021) and Huang et al. (2022) regarded the design of a DCT-application, more specifically the ease of use, as a factor that would

increase uptake and usage, while concerns about privacy lowered the chance of utilization. One study also addressed concerns about whether an application would actually work or not, along with problems addressing high battery consumption (Garousi et al., 2022), a problem also prominently mentioned when talking about the first iteration of Smittestopp (Sandvik, 2020).

3.1.4 Benefitting our research

For our study, Prakash & Das (2022) provided a systematic literature review for us. Their literature review, consisting of 18 studies, was aligned with our intentions to develop a study on DCT-applications. These studies were used to bring relevant theory into our research, and are later discussed together with our own findings. By supplementing their review with 6 relevant and recent studies, we could utilize an expanded literature review to bring more foundation to our study. Throughout this chapter, constructs and concepts based on theory from this expanded literature review are defined. Most importantly, through Prakash & Das' (2022) initial literature review, we found the study that would eventually become the main inspiration for our research, namely "*Privacy concerns and digital government: exploring citizen willingness to adopt the COVIDSafe app*" by Lin et al. (2021). Their constructs and framework has been beneficial for this study, and if not for Prakash & Das (2022), this inspirational study may have gone unnoticed to us.

3.2 Internet Users' Information Privacy Concerns

As we based our thesis' research model on Lin et al. (2021), we applied their theory model into our research, in order to develop our thesis around an existing relevant study. *Internet Users' Information Privacy Concerns (IUIPC)* is a research model developed by Malhotra et al. (2004), and was constructed in order to explain information privacy concerns (Malhotra et al., 2004). This model fit well with our study, and was integrated as part of our modified variant of Lin et al's (2021) research model as a second order construct. IUIPC is shown to be a good tool for explaining variance in a person's willingness to interact with and use different technologies and services (Bélanger & Crossler, 2011). Although many other studies make use of a different model; Concern for Information Privacy (CFIP) (Smith et al., 1996), this thesis stands to benefit more from IUIPC. IUIPC is an adapted variant of CFIP, that brings in the internet as context (Malhotra et al., 2004). Other studies have shown that these two theories work well when applied together (Fodor & Brem, 2015). In our study, we intended to

use IUIPC alone, and not in conjunction with CFIP, mainly because of what we base our model on. This has also been shown to deliver good results previously (Cockcroft & Heales, 2005).

IUIPC consists of three dimensions; *awareness*, *collection*, and *control*. These three concepts functioned as first order constructs for our research model. As described by Malhotra et al. (2004), all of these three dimensions each represent different types of concern. *Awareness* refers to the degree a consumer is concerned about their awareness of organizational information privacy practices. *Collection* describes a person's concern about the amount of individual-specific data that others may possess in relation to the benefits that are received. *Control* refers to whether a person has control over their personal information by having the power to modify, approve or opt out of a service (Malhotra et al., 2004). The IUIPC was later measured based on these three instruments, in order to see whether or not IUIPC had a direct impact on trust and risk beliefs of individuals, thus, having an indirect impact on intention to use a DCT-application (Lin et al., 2021). The full model can be visually seen and further explained in [chapter 4.1](#).

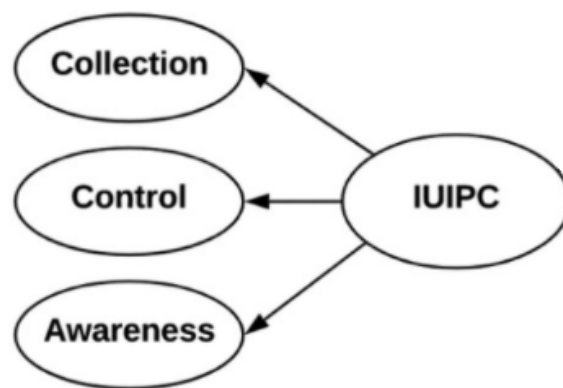


Figure 5 - The second order construct of IUIPC, consisting of the three dimensions collection, control and awareness (Lin et al., 2021).

3.3 Trust, risk and relative advantage

Terms and expressions on trust, risk and relative advantage in regards to governmental digital solutions and privacy have been mentioned persistently throughout this chapter when talking about COVID-19, contact tracing and personal data. Our thesis study adapted the concepts of

trust and risk beliefs, as well as the relative advantage of using Smittestopp, from Lin et al. (2021) in order to measure UIIPC. We have, however, also used additional sources for literature when defining the following concepts, as we utilized an extended literature review by Prakash & Das (2022) to build foundations for our research. Trust, risk and relative advantage, together with UIIPC and the relevant literature we established, heavily influenced our proposition for hypotheses.

3.3.1 Trust beliefs

Trust is considered both a fundamental and critical constituent of all human relationships, and various conceptualizations of trust have been defined, including positive beliefs, personal traits, action and social structure (Das & Teng, 2004). Trust beliefs have often been discussed in literature that touches upon technology acceptance, and are often found to be positively correlated with the intention to use technology (Oldeweme et al., 2021). While individuals' trusting beliefs has been shown to increase intention to engage in organizational information exchange (Nicolaou & McKnight, 2006), other studies have also found that successful launch of mobile applications to fight the pandemic relies strongly on citizens' trust in the technology itself (Parker et al., 2020).

3.3.2 Risk beliefs

According to Das & Teng (2004), trust has often been conventionally linked to *risk*, as the logic of risk occupies an indisputably important position in defining trust. They also claim that theorists have disagreed on conceptualizations of risk several times, but that most definitions suggest ideas such as uncertainty and/or variance in outcomes (especially losses) of some significance (Das & Teng, 2004). Risk beliefs in the context of technology acceptance and use has often been divided into three categories, performance risks, privacy risks and social risks (Oldeweme et al., 2021). Oldeweme et al. (2021) defines these three categories as such:

Performance risks	Concerns on whether or not the product/app works and performs.
Privacy risks	User concerns about data security, leaks, misuse by third parties.
Social risks	Fear of social pressure, exclusion and potential loss of social status.

It has been important for us to address all these aspects of risk beliefs, as they all might have a different impact on whether an individual chooses to adopt a DCT-application such as Smittestopp.

3.3.3 Relative advantage

In our context of *relative advantage*, we referred to the latest definition by Rogers (1995), who introduced the concept in 1962, and has continuously reiterated it. Relative advantage was described as the degree to which an innovation is perceived as being better than the idea it originally stems from, often guaranteeing economic profitability (Rogers, 1995). Also, Rogers (1995) explains that the nature of this innovation largely determines what specific type of relative advantage is important to adopters, which in our case was the importance of digital solutions to contact tracing applications adopters. Since then, other researchers have been using the concept of relative advantage in a more technology focused research area. For instance, relative advantage has been found to be positively related to intention to encourage knowledge sharing in an organizational IT support climate (Lin & Lee, 2006). Especially relevant for our study, Lin et al. (2021) found relative advantage to significantly affect intention to use COVIDSafe.

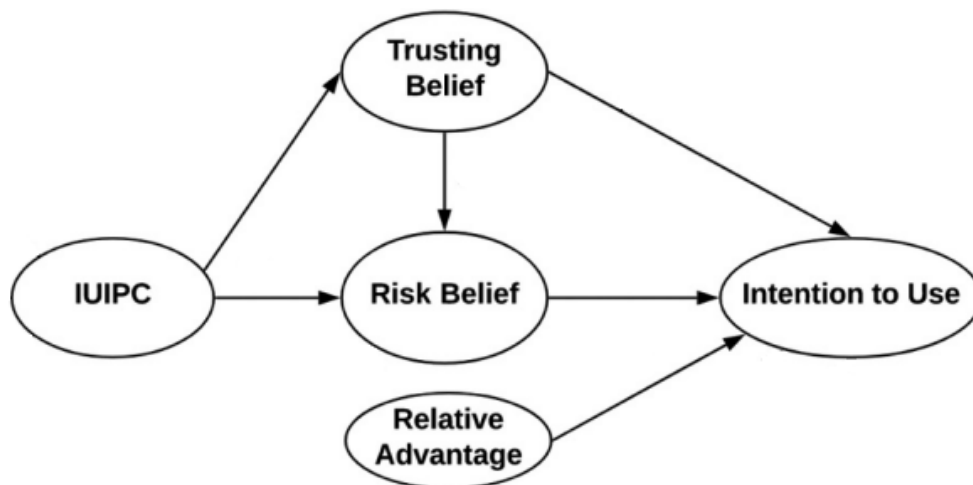


Figure 6 - The concepts of trust beliefs, risk beliefs and relative advantage as seen being formatively influenced by IUIPC, according to Lin et al. (2021).

3.4 Emotions

To uncover more research on DCT-applications, we chose to explore human *emotions*. There are multiple reasons for measuring emotions. As COVID-19 altered the daily lives of most individuals globally, physical and financial consequences were inevitable. Due to the sudden changes to the society, COVID-19 impacted a lot of people emotionally as well (Choudrie et al., 2021). We want to explore whether these emotions have formed strong opinions and concerns on IUIPC and especially Smittestopp. There could be several reasons as to why a user would want to use a new system or technology, and on the contrary, why someone would not. Users' emotions have been shown to affect IT use in the early stages of implementation (Beaudry & Pinsonneault, 2010). User satisfaction and how they perceive a service is also directly tied to emotion (Wang et al., 2009). When a person expresses positive emotions towards a product they should be more likely to engage with it. It has been shown that for example ease of use has direct relations to user satisfaction (Wang et al., 2009). Emotions have an important role when making decisions and individuals may turn to their emotions as a source of information, in the absence of clear information (DeSteno et al., 2004). Various studies have examined their relations with behavioral intentions in e-services and their role as a moderator has been proposed (Pappas et al., 2017). Researching emotions differs from Lin et al. (2021), and was added to see whether they had moderating effects to existing construct relations to uncover new research.

Emotions are divided into two groups; positive and negative, but there is more nuance to emotions that can help shed more light on the feelings of individuals. We have, for this thesis, adapted the construct for emotions from Scherer et al. (2013) which is further elaborated by Pappas et al. (2016). They categorized emotions into four subcategories; strongly positive, strongly negative, weakly positive, and weakly negative (Scherer et al., 2013; Pappas et al., 2016). Giving more nuance to the measuring of emotions can, in turn, provide a more nuanced explanation for users' behavior and intention to use. For our thesis, however, we only borrowed 20 emotions and put them into the two main groups; positives and negatives.

Table 3 - The 20 different emotions, ranging from strongly positive and negative to weakly positive and negative, borrowed from Pappas et al. (2016) to be used in the quantitative part of our study.

Strongly Positive (5)	Strongly Negative (5)
Pleasure	Anger
Joy	Hate
Pride	Contempt
Amusement	Disgust
Interest	Fear

Weakly Positive (4)	Weakly Negative (6)
Contentment	Disappointment
Admiration	Shame
Love	Regret
Relief	Guilt
	Sadness
	Compassion

All these 20 emotions were eventually used in our survey to determine whether or not they affected existing relations. Specifically, we measured positive emotions as a moderating effect to relative advantage → intention to use, and negative emotions as a moderating effect to risk beliefs → intention to use. Thus, emotions indirectly affect the intention to use DCT-applications.

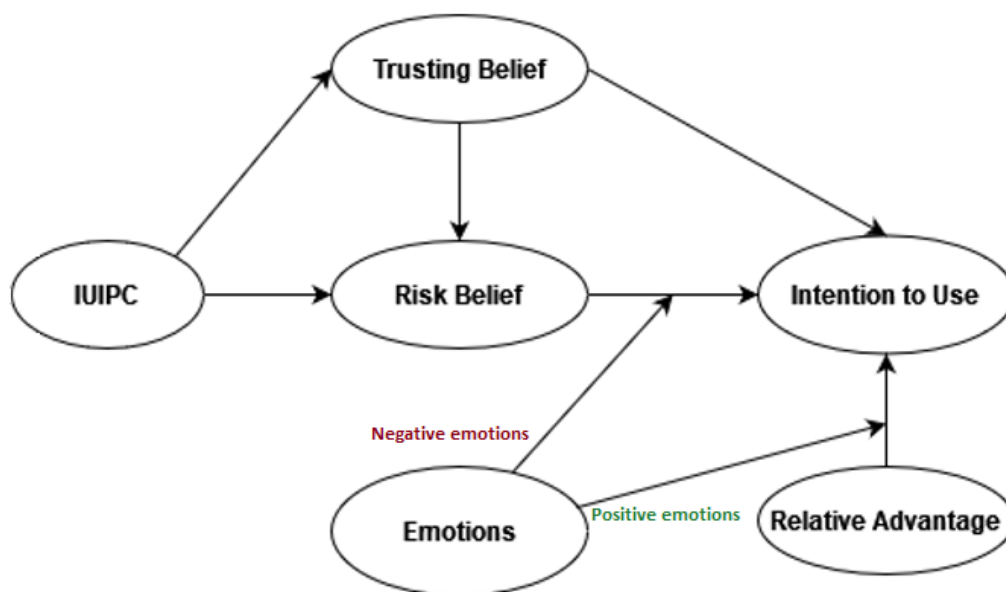


Figure 7 - Human emotions as moderators to risk beliefs (negative) and relative advantage (positive).

Throughout this chapter, all theoretical constructs needed in order to answer our RQs have been provided and defined. We also deliberately broke down and visualized each theoretical concept and constructs, providing a step-by-step walkthrough of our research model and its interrelations. The upcoming chapter will present the full research model, consisting of each concept that was just presented, along with suggested hypotheses.

4. Research Model and Hypotheses

This is a continuation of the previous theory chapter, where all the different constructs and concepts have now been put together. Thus, the full theoretical framework and research model which we based both our mixed methods research around, are being presented in this chapter. Also, we presented several hypotheses, so that we were able to test our collected data against these in the later stages of the study.

4.1 Research model

As presented in chapter 3, the research model we adopted for this thesis uses the second order construct of UIIPC, consisting of the three first order constructs: collection, control and awareness. Additional constructs consist of emotions, trusting and risk beliefs. From Lin et al's (2021) research model, we have adopted all relations and constructs except for perceived ease of use and compatibility. Since these two constructs only have a single relation and are included to find more reason for intention to use, we decided to exclude them as we include emotions instead. We have explained and gone through most of the constructs present in this model already, but one distinction that is important to discuss is the difference between intention to use and use. The aim of having this in the model is to operationalize and find if a person's intention to use a DCT-app influences them into actually using the app. Measuring this shows if any of the constructs eventually affect the usage of a DCT-application.

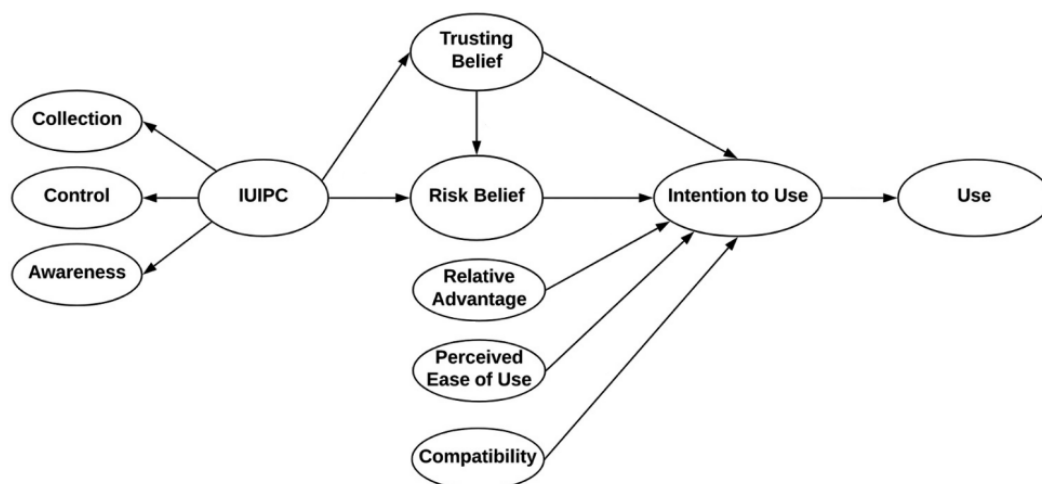


Figure 8 - The original instruments and concepts that were used as the theory model in Lin et al. (2021), on their study on the Australian contact tracing application COVIDSafe.

In our adopted model, we have modified it by including emotions as moderators between some of the constructs. As a result of the preliminary distribution of our questionnaire, we found through quick analysis that emotions could have a mediating effect between risk beliefs and intention to use as well as relative advantage and intention to use. This replaced the two constructs that we excluded, because we expected compatibility to not be an issue as the app was available for both iOS and Android. Ease of use was also not expected to be an issue as the app only requires a person to install the app and nothing else.

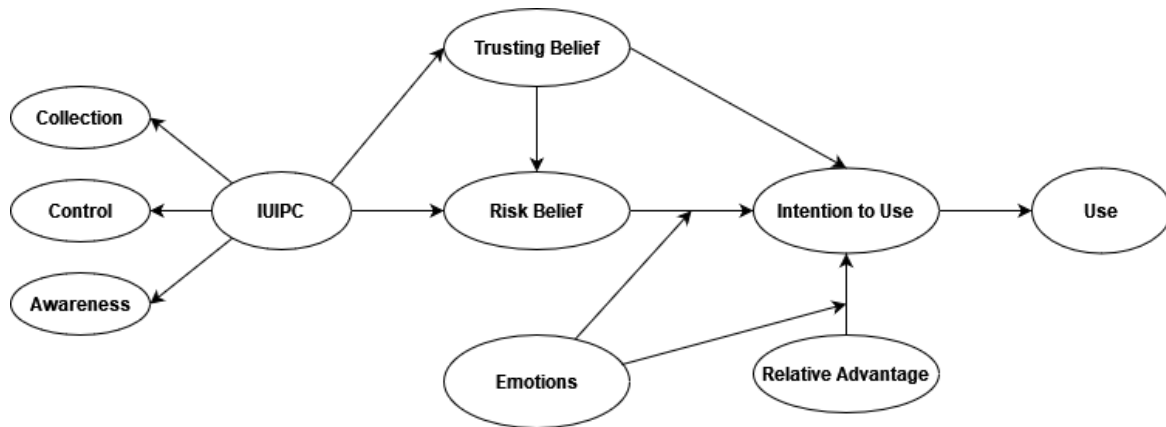


Figure 9 - Our model, highlighting emotion data (Pappas et al., 2016) as moderators to risk beliefs and relative advantage.

4.2 Hypotheses

Our first 6 hypotheses were mostly akin to the hypotheses developed by Lin et al. (2021), as we were investigating the same research area with two relatively similar DCT-applications. However, in addition to these hypotheses, we developed some of our own regarding the moderating influence of emotions, adapted from the study of Pappas et al. (2016). These hypotheses were backed up by relevant background literature from our own extended literature review of Prakash & Das (2022). We had in total 9 hypotheses that we aimed to explore and test with a survey questionnaire and follow-up interviews.

Trust factors such as the ability to trust and integrity are affected by privacy violations (Martin, 2018). In a study conducted by Kumar et al. (2018) it is revealed that the intention to disclose information to a service mediates the relationship between trust and the service. If a user has had a positive experience with the service from before, trust is also significantly impacted (Kumar et al., 2018). Trust has on other occasions also interacted and predicted

privacy concerns (Xie & Karan, 2019). An internet users' information privacy concern is shown in previous literature to interact with and have relations to trust. Therefore we intend to examine the impact of internet users' information privacy concerns on trust in regards to using DCT-applications like SmitteStopp. Thus, we propose the following hypothesis:

H1 Internet users information privacy concerns will have a negative effect on trusting beliefs

Privacy concerns have been shown to affect risk beliefs (Zhou, 2011). As internet users' information privacy concerns are based on a person's awareness, control and thoughts on collection, we had ample reason to believe that risk beliefs would be affected. How aware a person is of technology should affect their view of the risks involved with using it. A survey conducted in 2013 by Lankton & Tripp (2013) involving 322 facebook users proved a significant relation between privacy concern and risk concern, where the former had a positive effect on the latter (Lankton & Tripp, 2013). Since these two variables interact in many ways there should be good reason to believe that one should have some effect on the other. Therefore, we believe that this hypothesis will be supported by our research. We then propose:

H2 Internet users information privacy concerns will have a positive effect on risk beliefs

We hypothesized that trusting beliefs had a negative effect on risk beliefs when it comes to Norwegian citizens' views on adopting Smittestopp. This is due to several findings from relevant background literature. Lin et al. (2021) reaffirmed support for their own hypothesis on trusting beliefs having a negative impact on risk beliefs, having found that trust had a negative effect on risk, and instead increased the intention to use the Australian COVIDSafe application. Also, most studies reviewed in our extended literature review from Prakash & Das (2022) that touched upon trust beliefs, did not mention that risk beliefs had any correlation with trust (Hassandoust et al., 2021; O'Callaghan et al., 2021; Duan & Deng, 2021). In one study, Oldeweme et al. (2021) found that trust in government and social influence fostered the adoption process of DCT-applications, and that usage of said applications reduced perceived privacy and performance risks, implying an indirect negative effect trust has on risks (Oldeweme et al., 2021). Thus, we propose:

H3 Trusting beliefs will have a negative effect on risk beliefs

There are several studies which found that risk beliefs have a negative impact on intention to download and utilize a DCT-application (Hassandoust et al., 2021; O’Callaghan et al., 2021; Duan & Deng, 2021). Risk is often mentioned as a factor of concern in regards to privacy and security (Altmann et al., 2020), moreover, concerns surrounding self-disclosure leading to possibilities of getting hacked, or data getting leaked (O’Callaghan et al., 2021). Depending on what individual you ask, adapting the application could mean protecting yourself, family and friends from COVID-19 (Hassandoust et al., 2021), while not adapting the application could mean protecting your family and friends from personal data leakage (O’Callaghan et al., 2021). However, as most of the studies show that risk beliefs lead to individuals not adapting a DCT-system, we hypothesized that Smittestopp would not be any different.

Because of this, we propose:

H4 Risk beliefs will have a negative effect on intention to use the Smittestopp-app

Several studies suggest different findings, and are divided on whether or not trusting beliefs have a positive or negative influence on intention to use. Altmann et al. (2020) found that general lack of trust in government, as well as concerns about privacy and security, were main impediments against the use of DCT-applications. On the contrary, Lin et al. (2021) and Kaspar (2020) expressed that trust in technology, as well as in the applications itself, were associated with adoption intentions of DCT-applications. Furthermore, trust in government and technology have been seen to be major determinants on individuals’ intention to continue to use DCT-technology in order to reduce spread of coronavirus (Prakash et al. 2021). Based on the general consensus concerning the emergence of the second and third iteration of Smittestopp and its improved privacy technology (Folkehelseinstituttet, 2022), our hypothesis would back the implications from Kaspar (2020), Lin et al. (2021) and Prakash et al. (2021).

We propose the following hypothesis:

H5 Trusting beliefs will have a positive effect on intention to use the Smittestopp-app

Relative advantage and perceived self-benefits has been shown to positively influence individual’s willingness to download and use DCT-applications in the past (Lin et al., 2021; Walgrave et al., 2020; Trang et al., 2020). Lin et al. (2021) uncovered that relative advantage would increase intention to use, as most Australians would be willing to embrace mobile digital technology instead of manual paper-based solutions when it comes to contact-tracing. Due to the similarities in technology and purpose between Smittestopp and COVIDSafe, the

impact of relative advantage on individuals' intention to use the app is hypothesized to be similar on Norwegian citizens. For our hypothesis proposition, we propose:

H6 Relative advantage will have a positive effect on intention to use the Smittestopp-app

As we hypothesized that risk beliefs will have a negative impact on intention to use (H4), we chose to explore negative emotions as a moderating effect on that relation. The concept of emotions has been shown to affect intention to use and adoption (Beaudry & Pinsonneault, 2010). Bringing these two variables together to find a moderating effect could show some interesting results. A person's risk beliefs could affect their intention to use, but if the person also feels negative emotion towards the service, there could be an even stronger effect.

Negative emotions have a significant effect on the intention to adopt a new system (Zheng & Montargot, 2021). We therefore suggest that negative emotions moderate the relationship between risk and intention to use. Hence, we propose:

H7 Negative emotions moderate the relationship between risk and intention to use

As we hypothesized that relative advantage would positively affect intention to use (H6), we explored positive emotions as a moderating effect on that relation. It would make sense that if one feels positively towards a service, one's perception of the advantages using that service should be stronger. Positive emotions have been shown to be related to perceived benefits in another study (Ding & Chai, 2015). Relative advantage in our case is a person's perception of the advantages that come with using a DCT-app like Smittestopp. Perceived benefits can be defined as a person's perception of what they gain by adopting a service or technology. As such we surmised that positive emotions could also have relations to relative advantage. We propose the following:

H8 Positive emotions moderate the relationship between relative advantage and intention to use

In our research model, the last two constructs are intention to use and actual use. With all our hypotheses, we tried to explore concepts that affect intention to use, but how these affect actual use is still not measured. Intention to use has previously been shown to affect use of a DCT-app (Oldeweme et al., 2021). Logically it would make sense that a person's intention to use a service increases the possibility of them engaging with the service by downloading and using it, as it has been studied before (Tao, 2009). While we explored several constructs that

can impact intention to use, we also chose to explore whether intention to use actually led to downloading and usage of the app. With this in mind, we have ample reasons to hypothesize that intention to use will have a positive effect on downloading and using Smittestopp, and therefore propose that:

H9 Intention to use will have a positive effect on downloading and using the Smittestopp-application

4.3 Research model with hypotheses

In total, 9 hypotheses were either adopted, modified or developed to create a theoretical framework for our study. By measuring the relational data between the concepts provided, we were confident that we could replicate the study of Lin et al. (2021) to Norwegian citizens, and also improve their study with the inclusion of emotional data (Pappas et al., 2016). This, as well as having added more recent theoretical background and literature to support our research in a post-restriction phase of the pandemic.

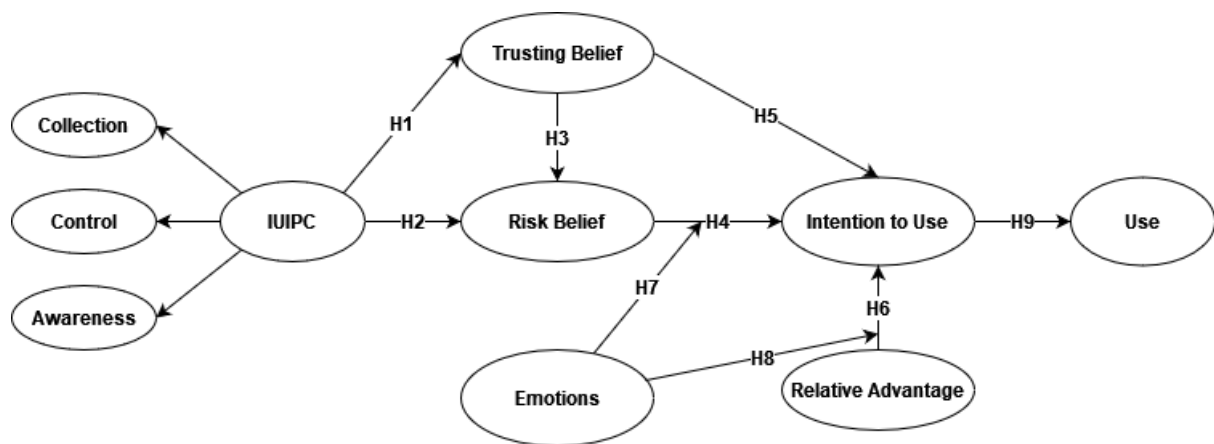


Figure 10 - Research model with hypotheses indicators.

5. Research Method Approach

In order to reach out to as many Norwegian citizens as possible, while also having the opportunity to explore in-depth thoughts and answers, we developed our thesis using a mixed methods research approach. Several years ago, it was believed that research studies should be situated in either a qualitative or quantitative approach, however, this has later been said to moderately restrict the work of the researcher (Leech et al., 2010). We decided early on to focus on collecting and analyzing both quantitative and qualitative data, as we believe this topic is exceptionally suitable for a mixed methods research method. Thus, we developed an anonymous survey questionnaire and an interview guide, and got approval from the Norwegian Centre for Research Data (NSD) to collect data with both approaches. The main focus of this research approach was to utilize a deductive approach in order to collect empirical data, followed by analysis and testing of hypotheses. This ensured the answering of the RQs as accurately as possible. The follow-up interviews would complement the data from the questionnaire.

In this chapter, the quantitative approach is explained first, which includes the setup of our questionnaire, how we found our sample, and the quantitative analysis procedure. After this, the same pattern will be applied to the qualitative part of our study, namely the follow-up interviews. The reasoning for doing a mixed methods approach is then presented. Before transitioning into our findings, we have explained how we validated our findings in order to deem them as credible results for this thesis, and reassured which research ethics we followed.

5.1 Research design

The purpose of a research design is to show the process of the different stages in which we planned, collected and analyzed data. As we decided to do a mixed methods study, we divided our plan into four phases. The first phase was dedicated to exploring existing literature that had been conducted within the chosen research area of DCT-apps. During this process, we searched for literature with relevant theories and models that could be expanded upon for further research. Then, we found a literature review and a research model that called for more research and exploration. In the second phase, we expanded the literature review with 6 studies and adapted the research model from Lin et al. (2021), thus, adjusting it for our study. From Lin et al. (2021), we also adapted some questions from a questionnaire. We then

prepared the questionnaire and distributed it. Phase three consisted of collecting and analyzing the quantitative data. The collection of data lasted about two months. During this time, we developed an interview guide based on what we wanted to explore further. Interviews were then conducted based on people who opted in for follow-up interviews from the questionnaire. The fourth and final phase consisted of structuring and analyzing the interview data as well as finishing up the study. With all data analyzed and visualized, we were more efficient when addressing and discussing them during the findings and discussion chapters. The writing of this thesis report occurred simultaneously with all phases. Figure 11 depicts all the phases of our research process.

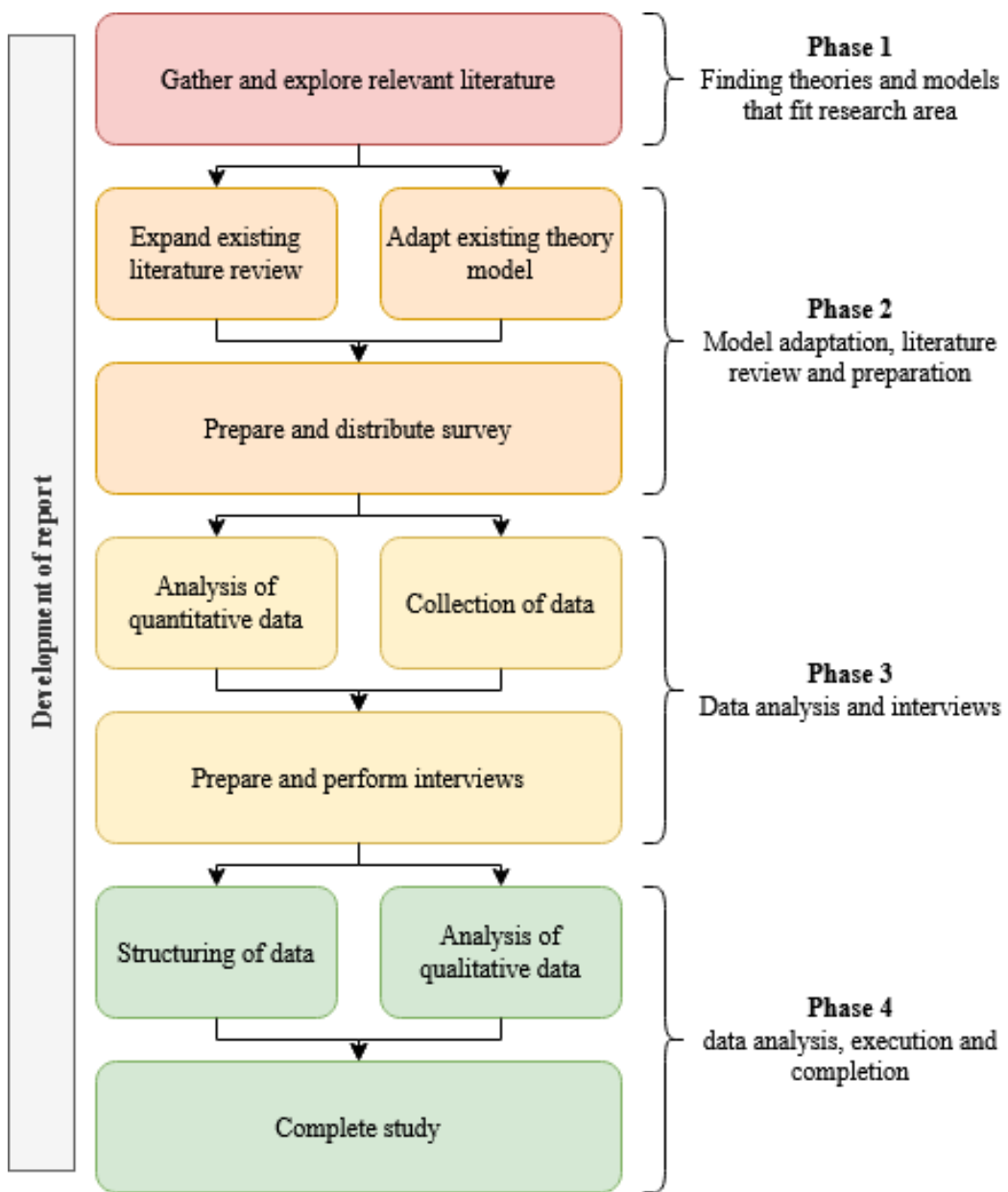


Figure 11 - Research approach.

5.2 Quantitative approach

For the quantitative part of our mixed methods study, we used a deductive approach. Then, we gathered relevant literature and theories, then developed hypotheses surrounding these. First of all, we conducted and analyzed a survey with a questionnaire and follow-up interviews, in which we received 189 valid responses.

Survey development

With modern technology, it is a relatively straightforward endeavor to produce and distribute a questionnaire online in order to reach a bigger and broader sample. Questionnaires are advantageous when it comes to quick distribution, and much lower cost in time and other resources (Regmi et al., 2016). From the University of Agder, we were provided a tool for conducting surveys, called SurveyXact. This tool was immensely beneficial for our study, as it could be used to create questionnaires, distribute them, monitor respondents and analyze the results in a simplistic fashion. Additionally, it is also highly concerned with data security and encryption, not collecting any IP-addresses or personal data externally (UiA, 2022). The questionnaire was also distributable and readable for both PC-users and mobile phone users, ensuring more accessibility.

Questions based on existing research

We adapted and made use of the majority of the survey questions from Lin et al. (2021), as well as their IUIPC model, when constructing our questionnaire. The questions were both translated and rewritten to fit the Norwegian government, using Smittestopp as the contact tracing application instead of the Australian COVIDSafe-app. We also left out parts of their questionnaire regarding perceived ease of use and compatibility, as we did not adopt these concepts from their research model. The last set of questions in our questionnaire presented a statement, followed by 20 emotions (Pappas et al., 2016). The participant could resonate with the emotion by answering anything from strongly disagree (1) to strongly agree (7) on a 7-point Likert scale.

In addition, we asked our participants about their age group, sex, level of education and other general questions, as we wanted to see if this information had any impact or relation to answers provided. Questions regarding a person's smartphone usage, and whether they were in a risk group or in close contact with anyone in a risk group, were also used. In any case, the


rest of the questions are adapted from Lin et al. (2021), with the 20 data measuring emotions being procured from Pappas et al. (2016). In the end, we gave our participants an optional choice on whether they wanted to get an update on the findings of our study, as well as an invitation to participate in a follow-up interview (see 5.3.1). These options required them to fill in their email-address, so we could contact them later. Other than that, the questionnaire was completely anonymous, and we could therefore not identify any person that did not voluntarily put in their email, in accordance with GDPR.

5.2.1 Questionnaire contents

As we based much of our study on existing theories, concepts and items from Lin et al. (2021), we reused their questions in a rewritten format to collect data. This was done to see how people in Norway perceived contact tracing applications (primarily Smittestopp), as well as their perception on control, collection, awareness, trust, privacy and risk in correlation with a digital government. Thus, we constructed our questionnaire with the following setup.

Introduction

This was the introductory part of the questionnaire, presenting both ourselves and our supervisor. We explained what our study revolved around, and what the data was going to be used for. Following this, we clarified the approval from NSD, and that the questionnaire would take around 5 minutes to fully complete.



UiA Universitetet i Agder

Use of the Smittestopp application, as well as thoughts and feelings surrounding the sharing of personal information online.

We are two students at the University of Agder, who are currently conducting a master thesis within Information systems. The topic of our thesis is use and perceptions towards the Smittestopp application from Folkehelseinstituttet (FHI), and personal data collection in general. The data will be used in a research paper that describes an individual's awareness, control, trust, risk and perceived benefits from using such applications. The study and further data collection is approved by the Norwegian center for research data (NSD) The survey is completely anonymous, and will take around 5 minutes to complete, and anyone can contribute. We hope that you want be a part of this study!

Students: Christian Ødeskaug & Tord Vetle Gjertsen Supervisor: Ilias Pappas

Figure 12 - Introduction to questionnaire.

General

The questionnaire starts with some general questions in order to see if these have any impact on the theory related questions. This would also provide us with demographic profiles. These were questions about age group, sex, education and population in their municipality. Additionally, we asked them questions about whether or not they owned a smartphone, used Smittestopp during the pandemic and if they were in a risk group for COVID-19.

Table 4 - General questions in questionnaire.

Indicator	Question
AGE	What age group do you belong to?
GENDER	What is your gender?
EDU	What is your highest level of education?
POP	What is the population of your municipality?
PHONE	Do you own a smartphone?
APP	Have you used the Smittestopp app during the COVID-19 pandemic?
RISKGROUP	Are you in a risk group or in close contact with someone that is in a risk group?
FUNCTIONS	Do you regularly turn off your phone's functionalities when you don't need them? (If you never turn these off, leave these boxes unticked)
FUNC1	WIFI
FUNC2	Bluetooth
FUNC3	Data

Awareness

From this section onwards, we borrowed questions from Lin et al. (2021), in order to supply their existing research with new, relevant data. These questions aimed to gather data on users' concerns and awareness of how their personal data is being used, as well as awareness on information privacy practices by using digital services (Malhotra et al., 2004).

Control

These questions revolved around Norwegians citizens' rights and control over their own personal information, as well as the importance of self-disclosing control when being online.

More specifically, control refers to whether a person has control over their personal data by having the power to modify, approve or opt out of a service (Malhotra et al., 2004).

Collection

This part of the study investigates users' willingness to share personal data to digital government services and whether this concerns them. We use the definition described by Malhotra et al. (2004): "collection describes a person's concern about the amount of individual-specific data that others may possess in relation to the benefits that are received."

Table 5 - Questions on awareness, control and collection of personal information.

Indicator	Question
Awareness (AWAR)	Answer the questions by reflecting on your own thoughts and feelings around the subject. (1- Strongly disagree, 7- Strongly agree)
AWAR1	The Norwegian government seeking information online should disclose the way the data are collected, processed, and used.
AWAR2	A good consumer online privacy policy should have a clear and conspicuous disclosure.
AWAR3	It is very important to me that I am aware and knowledgeable about how my personal information will be used.
Control (CONT)	Answer the questions by reflecting on your own thoughts and feelings around the subject. (1- Strongly disagree, 7- Strongly agree)
CONT1	Citizen online privacy is really a matter of consumers' right to exercise control and autonomy over decisions about how their information is collected, used, and shared.
CONT2	Citizen control of personal information lies at the heart of consumer privacy.
CONT3	I believe that online privacy is invaded when control is lost or unwillingly reduced as a result of a marketing transaction.
Collection (COL)	Answer the questions by reflecting on your own thoughts and feelings around the subject. (1- Strongly disagree, 7- Strongly agree)
COL1	It usually bothers me when the Norwegian government asks me for personal information online.
COL2	When the Norwegian government asks me for personal information, I sometimes think twice before providing it.
COL3	It bothers me to give personal information to so many Norwegian government agencies.
COL4	I'm concerned that the Norwegian government collects too much personal information about me.

Trust

To measure the level of trust a citizen has towards their digital government, Lin et al. (2021) proposed questions about trust regarding digital contact tracing applications, upkeep of promises regarding personal data, as well as predictability. Trusting beliefs have often been discussed in literature that touches upon technology acceptance, and are often found to be positively correlated with the intention to use technology (Oldeweme et al., 2021)

Risk

These questions explored risk beliefs regarding Smittestopp, sharing personal data to the government, uncertainties contra certainties, and the feeling of security a citizen has for their own personal data. Trust has oftentimes been conventionally linked to risk, as the logic of risk occupies an indisputably important position when defining trust (Das & Teng, 2004).

Table 6 - Questions on trusting and risk beliefs

Indicator	Question
Trust (T)	Answer the questions by reflecting on your own thoughts and feelings around the subject. (1- Strongly disagree, 7- Strongly agree)
T1	The Norwegian government would be trustworthy in handling Smittestopp information from Smittestopp app
T2	The Norwegian government would tell the truth and fulfill promises related to (my information) provided by me.
T3	I trust that the Norwegian government would keep my best interests in mind when dealing with (my information).
T4	The Norwegian government in general is predictable and consistent regarding the usage of (my information).
T5	The Norwegian government is always honest with citizens when it comes to using (my information) that I would provide.
Risk (R)	Answer the questions by reflecting on your own thoughts and feelings around the subject. (1- Strongly disagree, 7- Strongly agree)
R1	In general, it would be risky to give (my information) to the Smittestopp app.
R2	There would be high potential for loss associated with giving (my information) to the Norwegian government.
R3	There would be too much uncertainty associated with giving (my information) to the Norwegian government.
R4	Providing the Norwegian government with (my information) would involve many unexpected problems.
R5	I would feel safe giving (my information) to the Norwegian government

Relative advantage

Herein lies 4 questions in regards to downloading and using Smittestopp, exploring the participants' thoughts on advantages that could circumvent infection spread. Relative advantage was described as the degree to which an innovation is perceived as being better than the idea it originally stems from, often guaranteeing economic profitability (Rogers, 1995).

Download & Use

Does the questionnaire participant think it is worth downloading and using Smittestopp, as well as recommending it to others? These sets of questions aimed to reveal how individuals' conceive the importance of spreading the use of Smittestopp.

Emotions

This last segment of the questionnaire revolves around exploring human emotions. We presented the statement "*Downloading and using Smittestopp makes me feel:*", followed by 20 different emotions previously explained, borrowed from Pappas et al. (2016). By presenting this statement followed by emotions, the candidates could refer to a 7-point Likert scale when revealing how much they agreed or disagreed.

Table 7 - Questions on relative advantage, intention to use and human emotions.

Indicator	Question
Relative Advantage (RA)	Answer the questions by reflecting on your own thoughts and feelings around the subject. (1- Strongly disagree, 7- Strongly agree)
RA1	Downloading Smittestopp enhances the Norwegian government's effectiveness with contact tracing.
RA2	Downloading Smittestopp improves the quality of contact tracing.
RA3	Downloading Smittestopp enables the Norwegian government to trace coronavirus cases more quickly.
RA4	Overall, I find downloading Smittestopp would be advantageous for contact tracing.
Intention to Use (ITU)	Answer the questions by reflecting on your own thoughts and feelings around the subject. (1- Strongly disagree, 7- Strongly agree)
ITU1	It is worth it to download Smittestopp
ITU2	I will strongly recommend others to download Smittestopp

Emotions	Downloading and using the Smittestopp application makes me feel:		
Positive Emotions (PE)	Pleasure	Amusement	Admiration
	Joy	Interest	Love
	Pride	Contentment	Relief
Negative Emotions (NE)	Anger	Fear	Guilt
	Hate	Disappointment	Sadness
	Contempt	Shame	Compassion
	Disgust	Regret	

Email (optional)

Lastly, the questionnaire gave the participant an opportunity to voluntarily put in their email if they wanted to get an update on future results, or if they wanted to participate in a qualitative follow-up interview.

The full list of questions featured in our questionnaire can be found in exported format under [appendix B](#).

5.2.2 Questionnaire sample

We started collecting data publicly from February 7th 2022 to March 13th 2022, within the timeframe where most restrictions in Norway had been lifted. The survey questionnaire was first administered to close friends and family of ours, in which we received many recommendations and corrections from. This way, we were able to correct typos and mistranslations, reformulating the questions which were unclear to many. Shortly after, we distributed our questionnaire to even more participants, including friends, family and colleagues, who in return distributed the survey to people they knew as well. We also released the survey publicly by posting it on our public Facebook and LinkedIn profiles, in order to garner widespread attention on platforms where background and demographics would differ. Additionally, we also posted the survey to Norwegian community-based channels through the communication application Discord, as well as creating a post on the Norwegian subreddit on Reddit. This allowed us to distribute the survey to people outside our relations, while still being confined to a sample including only Norwegian citizens. We ended up with 189 valid respondents to our questionnaire, an amount relatively close to that of Lin et al. (2021). The

table of demographic profiles of our respondents can be seen in the findings chapter, under [6.1.1](#).

5.2.3 Quantitative data analysis

With our sample extracted as a CSV file in US format, we began analyzing and exploring our data. After we extracted our data, we cleaned up the file using a normal spreadsheet editor. The cleanup consisted of removing incomplete responses, shifting the weighting of questions that showed up negative in analyses. We also gathered the emails of people who had either shown interest in knowing the results of our study or wanted to participate in follow-up interviews.

While cleaning the dataset, we also needed to test it simultaneously. SmartPLS was used to run the dataset to look for discrepancies and values that were weighted poorly or wrong. SmartPLS is a software tool that does Partial Least Squares Structural Equation Modeling (PLS-SEM). By cleaning the dataset and evaluating it through SmartPLS simultaneously, we eventually ended up with a clean, complete dataset. Also, as our sample size grew, we found that the reliability and integrity of our data increased.

With a complete and clean dataset, we started to test it through different SmartPLS analyses and recorded all significant relations, factors and paths. Using both the PLS algorithm and bootstrapping, we had the data analyzed and compiled, giving us findings that would later be beneficial for the development of an interview guide. The interview guide was developed purposely to fill in the gaps of our questionnaire, but also to verify what we had already found. The results from our questionnaire analysis can be found under [6.1](#).

5.3 Qualitative approach

When we discussed how to elaborate on the research of Lin et al. (2021) for a Norwegian audience, we quickly determined that a qualitative approach would expand the research appropriately. While conducting a questionnaire felt obligatory in order to get many respondents quickly, follow-up interviews could contribute to the quantitative findings by exploring in-depth opinions face-to-face with an interviewee. Thus, we decided to supplement our questionnaire with 11 interviews, contributing with extensive empirical data. The interviews were semi-structured and open-ended, as we intended to have a general lineup of

questions with room for deeper discussion if the interviewee had more to discuss. We also aimed to interview people with different backgrounds and occupations, as we initially wanted to see if this affected the thoughts they provided. With an interpretivism focus, we looked at how we perceived and handled the data we received, and strived to gain a real world perspective based on the interactions with our interview subjects (Chowdhury, 2014).

Selection

We made the selection of interview participants straightforward by incorporating a volunteer-system into our questionnaire. Anyone could provide their email at the end of the questionnaire if they wanted to participate in a follow-up interview. Maintaining a strong privacy policy was also important for us, ensuring anonymity to the individuals who wanted to contribute to our research. The volunteers were informed on what the data they provided us with were going to be used for, and all 11 interviewees gave us 100% trustworthy consent. We also made sure to inform them on their rights according to GDPR, as well as our approval from NSD. We maintained confidentiality throughout the interviewing process by recording the interviews with encrypted software, more specifically “Nettskjema-diktafon”, developed by the University of Oslo (UiO). By using this application, we could record our interviews on our phones, but not listen to them internally. The recording had to be sent to the encrypted browser from Nettskjema if we wanted to make use of it (UiO, 2022). Throughout this process, the confidentiality of our participants were prioritized.

Interview questions

We speculated beforehand that most of our interviewees had different experiences and knowledge regarding our research area on DCT-applications. Hence, as mentioned, we used semi-structured interview questions. Doing this, the interview candidate answered leading questions, where we as interviewers could ask follow-up questions in places where the participant could further elaborate. We strictly avoided yes/no questions, and instead asked for further elaboration if the candidates provided such answers.

Question 1 was about whether or not the candidate had ever downloaded Smittestopp. This would set the tone for the rest of the interview, as we wanted to specifically explore why they had or had not downloaded the DCT-app. Then, we asked several questions relating to each of the theoretical concepts and constructs introduced in chapter 3, in the same manner as our quantitative survey approach. By the time we interviewed our candidates, we knew we wanted more data on awareness’ influence on trust and risk, due to lacking quantitative data.

Table 8 is an excerpt of the interview questions we used as a template for all our interviewees. Depending on the competence of the interview candidate, some of the questions were not fitting or needed.

Table 8 - Semi-structured interview questions.

Construct	Question
Relative Advantage (RA)	Semi-structured questions. Asked if applicable to the candidate. If not, additional follow-up questions were asked. Following questions are from the interview guide.
Question 1	Have you downloaded Smittestopp during the course of the pandemic? Why/why not?
Question 2	Do you think there are more pros than cons by downloading/using Smittestopp?
Question 3	Do you feel digital solutions like Smittestopp are helpful in fighting a global crisis like the pandemic?
Question 4	What do you think is the reason for the low usage of Smittestopp in Norway?
Question 5	Do you think there could be better digital solutions than Smittestopp to fight infection spread?
Awareness (AWAR)	Semi-structured questions. Asked if applicable to the candidate. If not, additional follow-up questions were asked. Following questions are from the interview guide.
Question 6	How aware do you feel you are, when it comes to how your personal information is being used online?
Question 7	Do you know any corporations/companies that collect personal information? What do you think about this?
Question 8	Do you know what they use your personal information for, and what do you think they use it for?
Question 9	Do you regularly update yourself on how your information is being collected and handled online? Why/why not?
Question 10	Do you feel safe giving your personal information to the Norwegian government?
Trust (T)	Semi-structured questions. Asked if applicable to the candidate. If not, additional follow-up questions were asked. Following questions are from the interview guide.
Question 11	How much trust do you have in various information collectors (e.g. Norwegian state or private organizations such as Facebook, etc.)?
Question 12	Are there any organizations you trust more than others? Why / why not?
Question 13	Do you feel that the state and / or other organizations are transparent and good at showing what they actually use your personal information for?
Question 14	Do you know anyone who distances themselves from the internet / social media due to awareness of personal information? Someone who has a lot of trust?

Risk (R)	Semi-structured questions. Asked if applicable to the candidate. If not, additional follow-up questions were asked. Following questions are from the interview guide.
Question 15	Do you feel there is any risk involved in sharing your information online? Why / why not?
Question 16	Do you actively try to reduce risk in relation to your personal information?
Question 17	Is there anything that can make you more confident in sharing your information online?
Question 18	Are there any cases where you have felt it was too risky to share your information with a new platform or service? Why / why not? Did it make you not engage with the platform / service?
Question 19	Are you afraid that personal information about you will get lost? (get leaked from e.g. social media)
Control (CONT)	Semi-structured questions. Asked if applicable to the candidate. If not, additional follow-up questions were asked. Following questions are from the interview guide.
Question 20	Is it important for you to have control over your personal data? Why / why not?
Question 21	What would you do if information about you had been leaked?
Question 22	What do you think about privacy laws and how they help protect you online?
Collection (COL)	Semi-structured questions. Asked if applicable to the candidate. If not, additional follow-up questions were asked. Following questions are from the interview guide.
Question 23	Do you mind sharing your personal information online? Why / why not?
Question 24	Are you thinking about and considering whether to share your information online?
Question 25	Do you feel like someone is asking for too much personal information online? For example cookies
Question 26	Have you ever stopped using a website or app due to them collecting your information?

The full interview guide, including some common follow-up questions can be found in [Appendix C](#).

Transcripts

Having completed all 11 interviews, we transcribed them into text format by using intelligent verbatim transcription methods. Intelligent verbatim transcription was used to convert the audio into text format, but omitting filler words and unnecessary clutter like laughs and coughs (Eppich et al., 2019). A great deal of time was put into making the transcripts completely faithful to the audio source, so that each opinion uttered by our volunteers could be used in our analysis. The transcripts did not include the names of our interviewees in order

to maintain their anonymity, but featured keywords such as age group, occupation, length of interview and date/time. This made it easier for us to distinguish the different individuals. After each interview was transcribed and reviewed, we deleted the recordings permanently. Further, we used these transcripts to analyze the received data thoroughly (see [5.3.2](#)).

5.3.1 Interview sample

The interview sampling process was done simultaneously with the data collection from the questionnaire. As more individuals completed our questionnaire, we gained an increased number of volunteers for follow-up interviews. We extracted emails of the voluntary participants into a CSV file, so that we could determine who to contact as we got closer to finishing the first draft of our interview guide. Conveniently for us, all the volunteers were people we had a personal connection with to some degrees. This made it easier for us to contact the candidates and schedule face-to-face interviews.

The sample of the interviews were a minuscule percentile of the questionnaire respondents, as we analyzed interviews from 11 candidates out of a total of 189 responses. A total of 13 people declared themselves as volunteers for a potential interview. We discussed internally who to pick out of these 13, as well as others who expressed interest after the questionnaire was completed. However, due to potential bias, we chose to interview all of the volunteers instead of hand-picking them. We interviewed 13 people, but unfortunately 2 recordings were lost in the process due to corrupt save files. This left us with the 11 analyzed transcripts which are now part of this study. Notably, as we dealt with non-professional individuals, we averaged the timeframe of our interviews around 25-30 minutes each, in order to maintain their interest. The interviewees of our qualitative study were entirely anonymous in accordance with [NSD's approval](#), and we made sure to keep their identity unidentifiable at all times. The anonymized demographic profiles for all our interviewees can be found in [6.2.1](#), where we further presented common traits and differences between them and what we found based on answers provided.

5.3.2 Qualitative data analysis

Due to our research being a deductive study with questionnaire data analyzed first, the theory and structure was already predetermined before our interviews analyses. We divided the set of questions into categories based on the constructs and hypotheses we wanted to compare our newfound empirical data against. But first, we had to convert the answers of our interview

candidates into measurable data. We started our analysis by transcribing the interviews based on encrypted recordings used in all of our interviews. These transcripts were added into Quirkos, a software specifically used for analyzing qualitative data through a visual interface. Quirkos is a Computer-assisted Qualitative Data Analysis Software (CAQDAS). The software allowed us to code and separate quotes and answers by annotating them with different color coded categories. These categories were then shown on-screen as colored circles, which increased in correlation with increased annotations. This continuously provided an idea of how big a category was, essentially how much it was being referenced to. This way, we could easily compare the amounts of references between the nodes visually. The program did the conceptualization for us, we just needed to name the circles with an assigned concept, theory or item. The visual interface in Quirkos also made it straightforward to segment the data, as the categories could be moved around, grouped and paired with similar concepts and theories. Whenever the nodes were clicked, e.g. “Trust”, the program would list every instance of where an interviewee mentioned trust as a concept.

Though Quirkos made much of the process of analyzing intuitive for us, how we chose to analyze the categories and provide the results was something we did thoroughly ourselves. We compared noteworthy quotes against theories and concepts from our background chapter, exploring whether they verified our introduced knowledge to our research. In total, we had 214 document pages of annotated and coded references from our interviewees. Then, we determined which of the answers and references were significant enough to be presented as results for our hypotheses, in order to ultimately answer the RQs. Results, screen captures and generated reports from Quirkos can be found under [6.2](#), where we present all the relevant findings from the qualitative analysis.

5.4 Combining our methods

Our thesis consisted of both quantitative and qualitative elements done in conjunction in order to increase the quality of research. Our mixed methods approach was complementary, meaning that we developed the methods to get complementary views about the same relationships and phenomena (Venkatesh et al., 2013). As seen in our research design, the questionnaire was distributed first to collect and analyze data. Then, the follow-up interviews were formed to further look into found gaps or relationships with lacking effect. Our methods also followed different research philosophies with our quantitative questionnaire being

positivist and follow-up interviews being interpretivist. This can be viewed as a contradictory research design, but the method of interpreting and explaining our findings follows a pragmatic philosophy. We recognise that there are multiple ways of interpreting and conducting research, and that no single point of view can give the entire picture (Johnson & Onwuegbuzie, 2004). As such, both deductive and inductive approaches are used as well as both objective and subjective ontology. These types of mixed methods research have been successfully conducted in the past (Keil & Tiwana, 2006).

A notable strength of mixed methods is the ability to corroborate and converge findings, but this type of research is demanding and time-consuming for a single person to carry out (Johnson & Onwuegbuzie, 2004). Fortunately for us, this thesis allowed for two students to partner up and collaborate on a report together. Ultimately, we believed a mixed methods approach would be more impactful based on our research area, and by combining our efforts, we pursued this challenge committedly.

5.5 Methods for validation

As validation of our findings is vital to uphold the liability and integrity of the study, we compared them with several key validation criterias presented by Tsang et al. (2017) and Whittemore et al. (2001), ensuring validity to both the questionnaire and interviews. We used these theories together with validity functionalities within data analysis softwares to easen up the process and mathematical formulas.

5.5.1 Validity of questionnaire

For validating a quantitative research method, in our case, we had to look at how responses from a distributed survey questionnaire can be validated. Validity in terms of a questionnaire is determined by how well the questions asked answers the RQs, and how well it measures what it is supposed to measure. In our case, these are the concepts and constructs borrowed from Lin et al. (2021) and Pappas et al. (2016).

Content validation

Subsequent validation factors are often divided into content validation and construct validation. Content validity revolves around whether or not the items in the questionnaire are representative of the theories it tries to assess (Tsang et al., 2017). This was not considered an

issue for us, as most of the questions are akin to those of Lin et al. (2021), only rewritten to better suit our research area in Norway and our RQs. We also rejected the use of questions regarding concepts we did not adapt, like compatibility and perceived ease of use, in order to only use questions that were relevant. Therefore, we used the procedure of face validity in order to determine the content of our questionnaire. We also had our supervisor validate our questionnaire before distributing it to respondents, ensuring further content validity. Regardless, each sub-chapter in the questionnaire and underlying questions were designed to garner data on each construct from the research model and hypotheses (see [chapter 4](#)).

Construct validation

Along with content validity, we also needed to look at construct validity. The construct validity of a questionnaire evaluates its capability to associate itself with pre-existing variables that measure the same points of interest (Tsang et al., 2017). Tsang et al. (2017) explains that construct validity is usually deemed the most important and challenging aspect of validating findings in quantitative research, as it measures a construct that is not directly observable by us as researchers. For our study, this would be constructs like IUIPC, which is the culmination of awareness, collection, control, trust and risk beliefs of internet users. Therefore, we aimed to measure these up against our developed hypotheses, in order to define an understanding on how these constructs influence each other, after analyzing their respective data. We spent a good amount of time validating the constructs of our qualitative research by using SmartPLS. We strived to achieve validity and reliability during all stages of the analysis with the help of several PLS calculations. Results of these can be found in [6.1.3](#).

5.5.2 Validity of interviews

On the topic of qualitative research, Whittemore et al. (2001) explained that validation of qualitative results could be separated into two aspects; both primary and secondary validation criterias. As part of the primary aspects, there were four criterias of validating qualitative result:

1. Credibility - Whether or not the results accurately present the responses.
2. Authenticity - Make sure that all participants are being heard.
3. Criticality - The critical appraisal of all the aspects within the research.
4. Integrity - The self-criticality of the researchers.

Along with these primary key validation factors, there are also some secondary criterias. These include factors such as creativeness, explicitness, thoroughness, vividness and sensitivity (Whittemore et al., 2001). We, however, chose to specifically focus on the primary key validation criterias above, as they were both suitable and varied enough to validate the results from our 11 interviews, as we are doing both a quantitative and a qualitative study

In qualitative research, there are theories that focus strictly on the topic of trustworthiness when validating results (Lincoln & Guba, 1985). Trustworthiness in a study was said to provide both internal and external validation, along with reliability and objectivity. The same concepts were something we also considered, as it was important for us that the relationship between the interview subjects and us were trustworthy. Each participant had a personal connection with at least one of us, which contributed to a more trustworthy and genuine setting while conducting the interviews with them.

After we transcribed our 11 interviews, we navigated thoroughly through each in order to validate them directly. In regards to Lincoln & Guba's (1985) theory on trustworthiness, all of the interview candidates gave us their consent orally. Additionally, we still referred to the four primary validation criterias by Whittermore et al. (2001) to validate our interviews. We offered credibility to our interviewees by transcribing the interviews using the intelligent verbatim transcription method, transcribing the thoughts and perspectives of our interviewees without filler words and noises. Using Quirkos, we could extract each individuals' quotes regarding a theoretical concept directly and accurately. Using the same transcription method, we made sure that each quote is authentic to its origin, thus, making sure that each participant was being heard. Also, throughout the whole qualitative research process, criticality and self-criticality were addressed, as there were some limitations and challenges of our study ([see 7.5](#)).

5.6 Research ethics and citing

As our research thesis leaned into the concepts of personal information and privacy concerns, upholding these values for our questionnaire respondents and interviewees were taken into consideration with utmost respect. We were also provided a lot of information regarding individuals' trust and risk beliefs, and thus, we maintained the anonymity of all our candidates throughout the whole study. For the quantitative part of our research, this can be looked at as

a weakness to the study. We did not have an oversight over those who actually completed the questionnaire due to concealed identities. However, when looking at all the responses, all seemed genuine and not performed by any bots as no anomalies were found. Nonetheless, the genuinity of the respondents is worth addressing.

Consequently, as much of this research revolves around personal information, we think that keeping the respondents' anonymity in order actually increased the number of people who completed the questionnaire. We also believe that maintaining anonymous candidates would make them more susceptible to wanting to contribute to a follow-up interview. All the respondents were informed of anonymity, NSD and GDPR, as well as how we used their data and processed it. They all gave us their complete trust, knowing that they could cancel the questionnaire or interview at any time and withdraw their provided information from the record.

Fundamentally, as our research draws from existing research and theories, we were very careful to cite information correctly, and clarify that much of our research is based on the study of Lin et al. (2021) by their demand and call for research. To avoid any plagiarism, we thought it best to cite more often than not, thus, making it paramount to credit the work of other researchers' by referring to them in accordance with the APA7th standard. We would have never achieved our goals if not for all of these researchers, and wanted to acknowledge the respective authors and their works of research with respect.

6. Analysis & Findings

This chapter encompasses the presentation of findings from our quantitative survey with questionnaire, as well as the qualitative follow-up interviews. We also included the presentation of demographics and background information from our sampling in this chapter. With the collected general information from our questionnaire participants and interview subjects, as well the answers they provided to both research methods, the analysis we performed on both approaches proposed interesting, applicable and advantageous findings.

Firstly, we introduced the findings from our quantitative research, and what information our analysis provided us with. After highlighting demographic frequencies, we included tables from SmartPLS, with reliability and validity tables, as well as tested hypotheses based on the IUIPC model (with emotion data) borrowed from Lin et al. (2021) and Pappas et al. (2016). We did this in order to validate the responses from which we got from our questionnaire respondents, ultimately confirming or disconfirming the suggested hypotheses in order to answer our RQs.

Then, the results of our qualitative findings are provided. The tables and figures included interviewee demographics, screen captures of analyzed visualized data from Quirkos, as well as reports of coded references and frequencies based on our theoretical constructs. Quirkos was a digital tool we used diligently in order to turn our transcribed interviews into measurable data. Using quirkos, we were able to extract noteworthy quotes from each of our candidates easily through different visualized nodes (called quirks).

6.1 Findings from questionnaire

In this section, we first presented the differences in demographic profiles, as well the outcomes of our validations and analysis. The analysis provided us with answers on whether our previously stated hypotheses were supported in conjunction with our RQs.

6.1.1 Questionnaire demographic

One of the first things we did when analyzing our dataset, was to use SPSS to generate percentages and frequencies of the users' demographic profile based on the survey respondents.

Table 9 - Users' demographic profile.

Demographic	Frequency / Percentage
Age	
< 24	67 / 35.5%
25 - 34	66 / 34.9%
35 - 44	36 / 19.0%
45 - 54	12 / 6.3%
55 - 64	5 / 2.6%
65 - 74	1 / 0.5%
75 or older	2 / 1.1%
Gender	
Female	76 / 40.2%
Male	111 / 58.7%
Other	2 / 1.1%
Education	
Primary school	4 / 2.1%
High school	46 / 24.3%
Vocational school	14 / 7.4%
University or college	124 / 65.6%
Does not want to share	1 / 0.5%
Population of municipality	
100 – 999	2 / 1.1%
1 000 - 4 999	24 / 12.7%
5 000 - 9 999	12 / 6.3%
10 000 - 19 999	23 / 12.2%
20 000 - 39 999	17 / 9.0%
40 000 - 99 999	44 / 23.3%
100 000 or more	67 / 35.4%
Owns a smartphone	
Yes	187 / 98.9%
No	2 / 1.1%
Used Smittestopp	
Yes	89 / 47.1%
No	100 / 52.9%
Risk group	
Yes	72 / 38.1%
No	117 / 61.9%
Functions turned off	
Wifi	31 / 16.4%
Bluetooth	76 / 40.2%
Data	58 / 30.7%

From our analysis, we found the frequency and percentages of the different demographics we asked about with our general questions. From Table 9, we found that most participants were younger than 34 years old. This grouping consists of 70,4% of our questionnaire participants. The third highest age group was 35-44 with 19%. With the lack of data from older age groups, it was challenging to use the demographic profiles to find any correlation between age differences and our variables.

On the question regarding higher education, we have a split between university and high school education. We can see that our sampling weighted heavily towards university level of education with 65,6%. Population of municipality has an almost equal spread between lower than 39 999 and higher than 40 000. With this spread of demographics, we tried to find differences between the biggest municipalities of Norway and the medium to small sized ones.

Among our participants, 47,1% had used the Smittestopp-app before. This split in demographics gives a great way to test if previous interaction with the app affects one's perceptions and feelings. The split between whether a person is in a risk group (or knows someone that is) in regards to COVID-19 is also usable. Here, we have an almost 40/60 split with the lower percentage belonging to those being at risk. Lastly, we asked what phone functions our participants usually had turned off. We found that 40.2% had Bluetooth turned off, 16.4% had Wifi turned off, and 30,7% had mobile data turned off. The questions were asked in order to determine if these were results of IUIPC.

6.1.2 Descriptive statistics

To gain more insight on our gathered data, we extracted descriptive statistics to help visualize numbers on minimums and maximums, means and standard deviations. As we can now see in Table 10, all constructs have gotten answers strongly agreeing and strongly disagreeing. The mean of all constructs except USE have a highest value of 6.136 and a lowest value of 2.200. Positive emotions (2.805) have collective mean higher than negative emotions (2.577). Standard deviation of all constructs except USE ranges between 1.093 at the lowest and 1.846.

Table 10 - Descriptive statistics.

Construct	Minimum	Maximum	Mean	Std. Deviation
AWAR	1	7	6.136	1.093
CONT	1	7	5.856	1.175
COL	1	7	4.437	1.733
T	1	7	4.580	1.588
R	1	7	3.446	1.607
RA	1	7	4.862	1.596
ITU	1	7	3.645	1.621
USE	0	1	0.530	0.500
PLE	1	7	2.470	1.545
JOY	1	7	2.680	1.552
PRI	1	7	3.040	1.721
AMU	1	7	2.640	1.522
INT	1	7	3.380	1.733
CNT	1	7	2.980	1.652
ADM	1	7	2.600	1.454
LOVE	1	7	2.260	1.437
REL	1	7	3.200	1.757
ANG	1	7	2.740	1.605
HATE	1	7	2.380	1.565
CPT	1	7	2.550	1.645
DISG	1	7	2.500	1.678
FEAR	1	7	2.900	1.749
DISA	1	7	2.980	1.846
SHAME	1	7	2.420	1.641
REG	1	7	2.490	1.668
GUILT	1	7	2.200	1.474
SAD	1	7	2.230	1.479
COMP	1	7	2.960	1.699

AWAR = Awareness, **CONT** = Control, **COL** = Collection, **RA** = Relative Advantage, **ITU** = Intention to Use, **USE** = Use, **PLE** = Pleasure, **JOY** = Joy, **PRI** = Pride, **AMU** = Amusement, **INT** = Interest, **CNT** = Contentment, **ADM** = Admiration, **LOVE** = Love, **REL** = Relief, **ANG** = Anger, **HATE** = Hate, **CPT** = Contempt, **DISG** = Disgust, **FEAR** = Fear, **DISA** = Disappointment, **SHAME** = Shame, **REG** = Regret, **GUILT** = Guilt, **SAD** = Sadness, **COMP** = Compassion

6.1.3 Reliability and validity

In SmartPLS, we used validity functionalities within the program itself in order to perform several measures within construct validity. For instance, we measured whether or not the contents within our study that should not be related to each other, were in fact, not related to each other. This type of construct validity is called discriminant validity (Cronbach & Meehl, 1955). In contrast, we also measured if the contents within our research that should theoretically be related were actually related, also known as convergent validity (Hubley, 2014). Construct validity (discriminant and convergent), in our study, were measured using well-known reliability and validity formulas named Cronbach's Alpha (CA) (internal consistency) and composite reliability validity (actual loadings) through SmartPLS. Moreover, we also measured all the variables' correlations in a correlation matrix and average variance extracted (AVE) with SmartPLS as well. To do this, we extracted the latent variable scores (LVS) of all constructs and used them to generate the needed information through bootstrapping and the PLS-algorithm.

We have illustrated our reflective measures in Table 11. Here, one can see that all but three indicators; T4, T5 and R5, have acceptable loadings above 0.700 (Hair et al., 2011). These were removed as the constructs gained increased CR as a result. Both the CA and CR values were higher than the recommended 0.700 as well, suggesting good reliability. Other indicators were also removed during analysis. When checking for moderating effects of emotions, we removed all emotions that seemed to have little to do with the situation. We took a step back and assessed what emotions made logical sense to associate with using an application and removed them in accordance to this. This in turn increased their overall moderating effects as well as their significance.

Table 11 - Indicator reliability, CA and CR.

Latent Variable	Indicator	Loadings	Cronbach's Alpha (CA)	Composite Reliability (CR)
Awareness (AWAR)	AWAR1	0.814	0.730	0.847
	AWAR2	0.800		
	AWAR3	0.801		
Control (CONT)	CONT1	0.743	0.717	0.840
	CONT2	0.836		
	CONT3	0.813		
Collection (COL)	COL1	0.902	0.890	0.924
	COL2	0.837		
	COL3	0.924		
	COL4	0.804		
Trust (T)	T1	0.840	0.896	0.923
	T2	0.914		
	T3	0.889		
	T4*	0.680		
	T5*	0.673		
Risk (R)	R1	0.813	0.883	0.914
	R2	0.798		
	R3	0.876		
	R4	0.831		
	R5*	0.698		
Relative Advantage (RA)	RA1	0.831	0.921	0.944
	RA2	0.945		
	RA3	0.914		
	RA4	0.904		
Intention to Use (ITU)	ITU1	0.940	0.867	0.938
	ITU2	0.939		
Positive Emotions (PE)	Pleasure	0.834	0.954	0.960
	Joy	0.890		
	Pride	0.881		
	Amusement	0.892		
	Interest*	0.764		
	Contentment*	0.893		
	Admiration*	0.854		
	Love*	0.800		
Relief	0.864			
Negative Emotions (NE)	Anger	0.836	0.944	0.946
	Hate*	0.918		
	Contempt*	0.910		
	Disgust*	0.925		
	Fear	0.708		
	Disappointment*	0.766		
	Shame	0.886		
	Regret	0.904		
	Guilt	0.701		
	Sadness*	0.725		
	Compassion*	0.159		

Note: * Removed due to low loading and/or not making sense in regard to being applied as a moderating effect.

An analysis using these formulas and measures was then undertaken. Construct reliability and validity are measured with AVE and CA. Reliability testing with CA as an indicator shows favorable results as the acceptable indices of internal consistency of the constructs all exceed the cutoff threshold of 0.70 (Tavakol & Dennick, 2011). The AVE of all constructs also exceeded the acceptable cutoff threshold of 0.50 (Bagozzi & Yi, 1988). All correlations in the correlation matrix are also lower than 0.80 and the square root AVEs for all of our constructs are larger than their correlations. These findings are presented in Table 12.

Table 12 - Descriptive statistics and correlations of latent variables

Construct	Measures				Construct				
	Mean	SD	CA	AVE	IUIPC	ITU	RA	R	T
IUIPC	5.37	1.37	0.853	0.534	0.659				
ITU	3.65	1.62	0.867	0.882	-0.183*	0.939			
RA	4.86	1.59	0.921	0.809	-0.102*	0.755**	0.899		
R	3.48	1.59	0.876	0.729	0.594**	-0.393**	-0.274**	0.854	
T	4.86	1.72	0.897	0.829	-0.361**	0.522**	0.413**	-0.601**	0.910

Note: Diagonal elements (in bold) are the square root of the average variance extracted (AVE). Off diagonal elements are the correlations among constructs (all correlations are significant, **p< 0.01; *p<0.05). For discriminant validity, diagonal elements should be larger than off-diagonal elements. IUIPC, Internet Users Information Privacy Concerns; ITU, Intention to Use; RA, Relative Advantage; R, Risk; T, Trust

6.1.4 Testing the hypotheses

Hypothesis testing was the last thing we did when analyzing the data from the questionnaire. As validity and reliability has been established through thorough analysis and testing, we could safely explore the constructs and the effects they had on each other. Our 9 hypotheses were all supported with varying degrees of significance and effect. With the lowest effect of a path weight of 0.102 and the highest of 0.781, there is a significant difference to the degree of effect between the hypotheses. We divided the effect of path coefficient weights into three categories of effect significance; > 0.500 indicates a large effect, a moderate effect is around 0.300 and > 0.100 indicates a small effect (Hair et al., 2011). Not all hypotheses were supported with the desired T-value above the 99.9%, but with the lowest value of 2.212 all were at least above 95.9%. This is still well within acceptable numbers to indicate a supported hypothesis. As expected from some of the lower path weights and T-values, some P-values were also greater than 0.01. None exceeded the threshold of 0.05 and as such none of our suggested hypotheses are null. The following model and accompanying text, visualizes and explains all hypotheses and their individual significance, reliability, validity and effect.

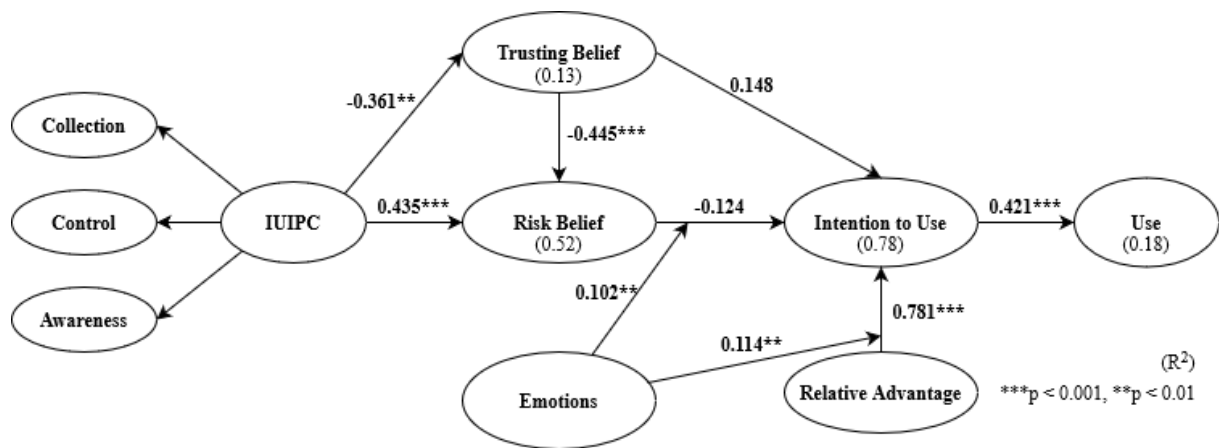


Figure 13 - Model with indicated path coefficients.

Hypothesis 1 is supported, with privacy concerns having a negative effect (-0.361, $p < 0.01$) on trusting beliefs. Hypothesis 2 is supported, with privacy concerns having a positive effect (0.434, $p < 0.001$) on risk beliefs. Hypothesis 3 is supported, with trusting beliefs having a negative effect (-0.445, $p < 0.001$) on risk beliefs. Hypothesis 4 is supported, with risk beliefs having a negative effect (-0.124, $p < 0.05$) on intention to use. Hypothesis 5 is supported, with trusting beliefs having a positive effect (0.148, $p < 0.05$) on intention to use. Hypothesis 6 is supported, with relative advantage having a positive effect (0.781, $p < 0.001$) on intention to use. Hypothesis 7 is supported, with negative emotions having a moderating effect (0.102, $p < 0.01$) on the relationship between risk beliefs and intention to use. Negative emotions have a moderating effect, which means that when negative emotions increase, risk beliefs effect on intention to use increases as well. Hypothesis 8 is supported, with positive emotions having a moderating effect (0.114, $p < 0.01$) on the relationship between relative advantage and intention to use. Positive emotions have a moderating effect, which means that when positive emotions increase, relative advantage's effect on intention to use increases as well. Hypothesis 9 is supported, with intention to use having a positive effect (0.421, $p < 0.001$) on downloading and using the Smittestopp-application.

Table 13 shows coefficients, t-values and p-values of all the tested hypotheses. Though all of our hypotheses were supported, some to a greater degree than others, we still wanted to explore the in-depth thoughts and perceptions of different persons. The next section presents the findings of our qualitative follow-up interviews, which is later discussed in correlation with the results from these quantitative findings in [7.2](#) and [7.3](#).

Table 13 - Hypothesis testing, with *t*-Values and *p*-Values.

H(#)	Path	Coefficient	<i>t</i> -Value	<i>p</i> -Value	Conclusion
H1	IUIPC → TRUST	-0.361	3.076	0.002	Supported
H2	IUIPC → RISK	0.434	6.179	0	Supported
H3	TRUST → RISK	-0.445	7.291	0	Supported
H4	RISK → ITU	-0.124	2.213	0.044	Supported
H5	TRUST → ITU	0.148	2.212	0.027	Supported
H6	RA → ITU	0.781	16.426	0	Supported
H7	NE → (RISK → ITU)	0.102	2.629	0.009	Supported
H8	PE → (RA → ITU)	0.114	2.963	0.003	Supported
H9	ITU → USE	0.421	6.993	0	Supported

6.2 Findings from interviews

To supplement our quantitative survey with a questionnaire, our mixed methods approach also provided qualitative findings from follow-up interviews. This was done through 11 interviews with participants from the questionnaire. The deductive analysis gave us findings in predetermined categorized theories, and by using the software Quirkos, we could analyze and extract findings directly from this software. After annotating all of our transcribed interviews, we started to look for results that were directly correlated to our hypotheses. As with the questionnaire, dividing conceptualized theories into categories in order to segment the findings was helpful. This ensured a straightforward process when comparing the results to the hypotheses in order to answer the RQs.

For this section, we started off by presenting some demographic profiles for our interviewees in order to differentiate them and highlight their uniqueness. Then, we presented screen captures and reports from Quirkos, showing the amount mentions and references towards conceptualized theories from [chapter 3](#) and [chapter 4](#), as well as additional relevant opinions. Lastly, we presented the findings directly by highlighting noteworthy quotes and opinions, separating them using different categories.

6.2.1 Interviewees' demographic

In order to showcase the diversity of our interviews, as well as similarities and differences between them, Table 14 shows the demographic profiles of all participants used in our qualitative interview approach:

Table 14 - Interviewees' demographic profile, differentiated by designated letters (sorted by age).

#	Occupation	Age group	Gender	Downloaded Smittestopp	Length	Date
A	Student	< 24	Female	No	30:40	18.04.22
B	Car mechanic	< 24	Male	No	21:44	21.04.22
C	Store employee	< 24	Male	No	37:57	10.04.22
D	Student	< 24	Male	No	26:26	09.04.22
E	Student	25-34	Female	Yes	31:07	22.04.22
F	Private security	25-34	Male	Yes	28:15	06.04.22
G	Civil engineer	25-34	Male	No	22:21	21.04.22
H	Student	25-34	Male	Yes	26:44	04.04.22
I	Public welfare	35-44	Female	Yes	19:06	20.04.22
J	Consultant	45-54	Male	Yes	18:10	04.05.22
K	Unemployed	45-54	Female	Yes	22:39	04.05.22

In order to ascertain and maintain the anonymity of our voluntary interviewees, we refrained from naming them, as well as presenting their specific age. Instead, we refer to the individual candidates by giving them a designated letter based on the Latin alphabet, in this case between A to K. The age has been concealed within an age group based on the age groups used in our questionnaire.

Based on these demographic profiles, we can see that most of our interview candidates were younger than 34 years old, with four of them being under 24. This is consistent with the questionnaire demographics. Having mostly a younger sampling can be considered a shortcoming on our end, but due to a tight timeframe, we still went through with it as these were volunteers from our questionnaire. We included gender to showcase diversity, though we do not think gender had any significant impact on our findings. However, what we found quite interesting was that essentially 6/11 (54,6%) of our interviewees had downloaded Smittestopp at one point. This is close to what we found in our quantitative research as well (47.1% out of 189 respondents), verifying our previously completed analysis.

Generating the report from Quirkos resulted in a document containing a table listing all nodes and their respective amount of references, as well as how many of our interview subjects mentioned specific nodes. From Table 15, we could then ascertain what our interviews leaned most towards in regards to constructs from the questionnaire analysis and opinions. The number of references per node shows the importance of the associated concept or construct.

Table 15 - Interviewees' references to concepts and opinions.

Title	Parent	Description	References Mentioned by	
Awareness		First order construct: How aware a users is regarding their personal data online	94	11
Control		First order construct: Control of one's own personal data	23	11
Collection		First order construct: Thoughts surrounding organizations who collect data	30	11
Relative Advantage		First order construct: Relative advantages of using Smittestopp	42	11
Risk		First order construct: Risk in relation to sharing information online	52	11
Trust		First order construct: Trust in online platforms.	59	11
Trust in government	Trust	Trust in government and how that affects usage of Smittestopp	43	11
Trust in private organizations	Trust	Trust in private organizations and how that affects usage of Smittestopp	25	11
Privacy concerns		Second order construct (IUIPC): Users' concerns regarding their private data online	57	11
Security	Privacy concerns	Concerns regarding the security of ones private data	14	4
Leaks	Privacy concerns	Concerns regarding information being leaked	13	5
Hacked/Breaches	Privacy concerns	Concerns of being hacked and having information stolen	16	6
Spam mails/Calls	Privacy concerns	Concern of getting spam call and mails	5	2
Smittestopp		Downloading and using Smittestopp	100	11
Battery consumption	Smittestopp	Mentions of high battery consumption of the app	4	3
Little use	Smittestopp	Talked about how little the app was used (others or self)	23	10
Non-functional	Smittestopp	Claimed that the app did not work, or had no use	16	5
Critique	Smittestopp	Public critique revolving Smittestopp	19	8
Effectiveness	Smittestopp	The effectiveness of the Smittestopp-app	12	7
Media	Smittestopp	Heard about smittestopp via the media	9	5
Lack of understanding	Smittestopp	Those who did not understand the app	21	5
Uninstalled	Smittestopp	Smittestopp was uninstalled	9	4
Emotions		Emotions related to DCT apps and similar technologies	15	8
Fear	Emotions	Fear of sharing and being stalked online	14	7
Annoyed	Emotions	When the interviewee mentions annoyance.	1	1
Policies		Different online policies regarding personal information	22	11
GDPR	Policies	GDPR Policies and thoughts on their usefulness	19	7

Facebook	Mentions of Facebook	23	11
Google	Mentions of Google	17	7
TikTok	Mentions of TikTok	3	3
Twitter	Mentions of Twitter	1	1
Snapchat	Mentions of Snapchat	5	3
Digital solutions	Digital solutions similar to Smittestopp	23	7
Manual contact tracing	Manual contact tracing solutions that do not use digital means	9	5
Tracking	Instances where the individual talks about tracking. Either GPS or tracing	30	8
Lack of competence	Lack of competence in organizations and/or development of digital services	12	5
Cookies	Cookies on websites and how they are perceived.	23	10
Personal information	When a person mentions their personal information online	126	11
Transparency	How open are media/government/private organizations about their products and security risks?	15	11
Acceptance	Acceptance of information gathering	19	5
Laziness	Laziness causing interviewees to not use Smittestopp.	37	6
Third-parties	Whether information is being sold to third parties etc.	8	5
Digital distancing	Distancing from technology, internet, social media etc.	4	4
Targeted ads	Thoughts on targeted advertisement	21	8
Total number of codes: 1118 Total number of nodes: 44			

6.2.3 References of relevance and significance

We garnered several references from our interviewees that contributed to our research. By categorizing the following concepts in a similar manner as our quantitative setup, we went through the references and opinions systematically step-by-step before comparing them to previously supported hypotheses from the questionnaire. As shown in [6.2.1](#), each interview candidate had been assigned a letter from A to K in order to ease the process of differentiating and referencing them individually.

Smittestopp

6 out of 11 interview candidates had at one point downloaded and used Smittestopp, but to varying degrees. While a few candidates tried to make use of the application to the best of their advantage, 4 out of these 6 adopters uninstalled the application rather quickly. 5/11 informed us that they had heard about Smittestopp through media coverage, but the equal number of candidates had heard widespread criticism of the application as well. Interestingly, when looking at the [demographic profile](#) of our 11 candidates, the younger half did not download Smittestopp, while the older half did. This implies that age differences might affect

one's perception of importance of the application. There was a general lack of knowledge of how Smittestopp actually worked, and what it aimed to achieve. This led people to not use the application or just blatantly uninstall it. 3 people also mentioned that the application drained too much phone battery, however, this did not impact their perception of the application. In interview B, the candidate believed that: *“most people in Norway are probably like me, they didn't educate themselves enough on the app and uninstall it when they heard skepticism. I just did not care for it, and used official guidelines and called the corona-number instead”*. The opinions on the application were not all just negative. All of our interviewees thought that a digital solution was the definitive way to handle infection spread of the pandemic, in contrast to manual solutions. A rather skeptical interviewee, candidate F, explained: *“I am all for digital solutions, as I have worked in places with manual solutions like pen and paper registrations. Digital solutions are simpler and more accurate, as well as harder to fabricate.”* Most, however, thought that Smittestopp did not work as intended, was privacy intrusive, and did not even know that there was an improved second iteration. Also, several stated that *“if only half the population used the app, then it will not benefit in any way”* (interview F, I, C), claiming that *“it would work better if the app was forced upon the population, though at the massive expense of privacy and free will”*. The general consensus was that the Smittestopp had good intentions but was rushed and executed poorly, causing most people to not care for it. None of the candidates were very happy with Smittestopp.

Awareness

Most of our interviewees claimed that they were quite aware of what their personal information was used for when using digital services. When we followed up with questions regarding examples of awareness, several of our participants informed us that they noticed cookies and targeted ads (B, D, E, F, G, J, K), with some of them even actively administering these cookies or declining them altogether. On the contrary, some of our interviewees told us that they were unsure about their awareness online, or that they weren't aware at all (A, C, H, I). Candidate G claims *“I always decline all cookies, and if that option is not there, I just leave the site and find another. I rather find a product myself than become the product of an organization. I do not want to be targeted with information when that information is usually terrible.”* Other interviewees were aware that their personal information was being collected on every site and app they visit, but did not really care. For instance, interviewee E uttered: *“Every interaction I have online results in me giving away my personal data.”*, however, several participants did not think of themselves as a target for malicious intentions: *“If*

someone wants to hurt me online, all they need to do is find my facebook from when I was 13. My info is already all over the place.” (interview D). When our interviewees were asked who they believed collected information about them, all of them answered Facebook, with Google being a prominent mention as well. Mentions of national services like health journals and banks were also mentioned by few. 5 out of 11 were also aware that the information they provided directly to different services could be sold to third-parties, resulting in them not knowing where the information would ultimately end up. Fortunately, all of our 11 interviewees were aware of privacy policies on the interview, with 7/11 knowing specifically about the GDPR. All our candidates believed that they were more aware of personal data collection than people they knew, or on mostly the same level.

Collection

All our candidates know that their personal data is being collected when using digital solutions, though not everyone necessarily knows or cares what for. When our candidates enter a new website or application, many of them are hesitant to accept cookies and signing in, showing restraint rather than clear willingness (B, F, G, J). They argue that they do not want to be targeted with continuous advertisements and products they do not really care for. Interviewee I did not know what cookies were for specifically, and just accepted everything. However, they admitted that *“I bought a gift for someone close to me once, but the surprise was ruined because they saw all the focused ads for that particular product on my tablet. They knew something was going on.”* For some candidates, sharing information has become second nature and they do it intuitively. *“Today, I feel like you have to share information anyways, so I am not negative towards it. I don’t share my social security number and such to every site though”* (interview K), showing that people differentiate types of sensitive information. 11/11 believed websites ask for too much personal information, though most could not elaborate specifically which websites. To varying degrees, all our interviewees consider whether to share personal data or not when using digital services.

Control

When asked about how they perceived control over their own personal data, not all of our candidates knew what this meant. Most of our interviewees confidently explained that they had control over their most sensitive data, like passwords and PIN-codes, and did not value other types of information as highly. *“What I need control over, I have control over. I do not need control over the information I choose to share”* (interview E). One candidate in

particular, interview A, did not care for control at all, saying *“I don't really need control. I trust organizations and services way too much, and I am confident that they won't ruin my life”*. Similarly, candidate G says: *“I have leaned towards no, so no it is not important to me”*. On the contrary, most of the interviewees valued control over their own personal data, not trusting every website with sensitive information, thus, deeming control an important aspect. Most of our interviewees make sure to regularly reset their password, and if they have been breached, they actively go out to fix the issue. However, candidate I does not change passwords, knowing perfectly well that they should due to being bombarded with notifications about it. More drastically, candidate F has refrained from reclaiming breached accounts if said account is not of use anymore, or has little ‘value’. Most of our candidates would not demand having leaked information about themselves removed online, and neither do they actively educate/keep themselves updated on privacy policies and GDPR. All our candidates seem to willingly give up control over personal data when it comes to corporations they trust more than others, like governmental institutions and to some degree facebook and Google. However, most claim to still only give up required information if possible, not unnecessary and sensitive information like social security numbers.

Trusting beliefs

In regards to trusting beliefs, we coded sentences and quotes about trust in general as well as sub-categorizing them. We divided them by two, annotating those who trust in government and those who trust in private organizations, if applicable. When asked about who they trust the most in regards to their private data, 8 out of 11 answered that they trusted the Norwegian government more than private organizations. Interview E gave us a quote that encapsulates a general thought that resonated well with all pro-government opinions: *“I trust the state the most because I want to be able to trust them”*. 3 out of 11 gave us contradictory opinions. Two were ambivalent towards who they trusted their data with, and the third answered: *“I trust big corporations more than the Norwegian government”* (interview F). Interview F backed up this claim by stating: *“I'm not afraid when it comes to Facebook and Google, because I look at them as very, very strict when it comes to their security network.”* (interview F). Trust also seemed to be tied with transparency, as some interviewees answered that they wanted transparency in order to trust an app or website (interview A, C, D, J, K). Trust in Smittestopp is also strengthened by trust in the Norwegian government, as the majority of our interviewees stated that one of the reasons they trusted in Smittestopp was that it was

developed by the government (Interview A, C, D, E, H, J, K). Trusting that the government would do what is best for the country, they believed that there would be less risks involved. In general, our interviews showed that trust is hard to achieve, especially online. All our interview subjects mentioned issues with trust and personal data online. A quote from interview G summarizes this by acknowledging: *“It takes 20 years to build trust, but only 20 seconds to break it”*.

Risk beliefs

Our interviews showed us that all our participants were in some way aware of the risks of sharing information online. As one participant mentioned: *“I was taught to be afraid of sharing my personal information”* (interview A). A pattern among our interviewees was that they were aware of the inherent risks of sharing personal information online, but took little to no steps to mitigate said risks. When asked if they take steps to decrease the risks they face online, 9 out of 11 said they do not think so. The rest mentioned actions and behavior they employ to avoid some risks of sharing, like changing passwords or avoiding websites that seem malicious. Some mentioned that they do not mind sharing personal information online, as well as using malicious websites simply because they have not yet faced any consequences of doing so. Interview H claims: *“I have used some websites that may not have been so good, but I haven't experienced anything bad by doing so yet”*. Most participants also thought that they did not pose as a target for information theft or being hacked, because they claimed to have nothing of importance that anyone would want.

Risk beliefs among our participants were mostly targeted towards the general fear of being hacked or something similar. 5 participants said that the potential of them using Smittestopp was diminished by potential risks while the 6 others did not feel there were any significant risks involved with Smittestopp. Generally, all our interviewees said that increased risk of using Smittestopp would lead to people not using the app.

Privacy concerns (IUIPC)

Privacy concerns were not something we inherently asked about during our interviews, but since it is a crucial part of our research model, participants would mention this quite often. Concerns often mentioned were centered around information like passwords and other access oriented information. One participant said: *“What I'm most concerned about is password leaks and the possibility of losing money”* (interview H). When coding the transcripts, we made sub-categories to distinguish different types of concern regarding privacy online.

Security, leaks, hacking/breaches and spam mails/calls were all mentioned enough to garner their own sub categories. 6 out of 11 interviews had mentions of either hacking or breaches. This shows that half our participants were aware of and had some concern for one of the consequences of having an online presence. 5 out of 11 mentioned leaks as a concern of theirs. When elaborating on a question, interview F said: *“What I’m actually afraid of is having my data leaked”*. Again, we see that about half our participants have specific concerns regarding privacy online. Security was mentioned by 4, and 2 mentioned spam calls or emails as concerns as well. By analyzing the interviews, we found that there are general concerns of privacy and to some extent specified reasons for concerns. In general, however, privacy concerns are low.

Relative advantage

As we wanted to explore our hypotheses and complement the questionnaire data further, we had some questions directly related to the perceived and actual advantages of downloading and using Smittestopp. Some felt the application did not pose any disadvantages already present with owning a phone: *“It’s just downloading it and using bluetooth which I’m already doing all the time so it doesn’t pose much of a disadvantage at least”* (interview E). Others felt there were no advantages either: *“I think few people used it so I don’t think there was anything to gain from using the app”* (interview C). The general consensus among our interviewees was that Smittestopp had no discernible disadvantages and that it was questioned if the application worked at all: *“I think the thought is good, but I don’t think Smittestopp worked as intended”* (interview G). We found despite about half our participants not having used Smittestopp, everyone agreed that what Smittestopp was meant to accomplish was an advantage worth having the app for. As we found relative advantage to have a significant impact on intention to use Smittestopp, we quickly determined that the follow-up interviews unanimously verified this hypothesis from the questionnaire analysis.

Emotions

We also tried to identify emotions while analyzing the transcripts, and two emotions were prominent; fear and annoyance. It is natural that fear would be mentioned when talking about privacy concerns and similar subjects. Fear has already been mentioned earlier, and is a prevalent subject matter when asked about risk beliefs. 7 out of 11 mentioned fear during the interviews, but not always to confirm their own fears. Rather, some would mention the lack of fear. When asked about concerns regarding their information being leaked or stolen, some

would mention that they were not afraid of this happening. The fear of being tracked also came up as a concern among our participants. Annoyance was only mentioned once, but it also gives context to concerns regarding private information leaks: *“I wouldn’t say it’s scary to have leaked personal information, but maybe a little annoying”* (interview I). Emotions were hard to gauge with our posed questions and interview guide. To analyze this further, we would have needed more specific questions to ask on emotions. However, we tried to keep the interview sessions short and concise.

Other noteworthy opinions

A prominent reason as to why some participants had downloaded and used Smittestopp was plain laziness. 6 out of 11 said that the reason they or others did not use Smittestopp was simply because it was a hassle to do: *“It seemed stressful to use it so i did not bother downloading it”* (interview D). One participant also mentioned that they knew a lot of people who did not care for Smittestopp either: *“I think most people I know don’t care in general as well”* (interview F).

Tracking was a topic we picked up on during our interviews as well. 8 out 11 of our participants had something to say about tracking. Everyone of these 8 people felt that tracking was intrusive and unwanted: *“I turn off everything that can track me as much as possible”* (interview D).

7. Discussion

In the first section of this chapter, the summary of our research is presented. Then, we discussed our findings and compared these to previously presented studies. Our hypotheses are then discussed thoroughly in order to answer both RQs. After this, we discuss the thesis as a whole, elaborating on how our mixed methods process went. Then, limitations and challenges are presented, as we have been self-aware that there have been some slight shortcomings in our research that ultimately limited our results. Lastly, implications for future research are then presented, as well as how this research study can be expanded to other research areas than just DCT-applications. This leads into the conclusion of this thesis.

7.1 Summary of research

This research study is part of a master's thesis in Information Systems at the University of Agder, and was developed by two students. The main purpose of this study was to examine citizen's willingness to adopt DCT-applications, based on quantitative and qualitative responses given post-COVID-19. Using a mixed methods approach, we borrowed the IUIPC model from Lin et al. (2021) after discovering their study in a literature review by Prakash & Das (2022). We adjusted their model and added human emotions from Pappas et al. (2016) as moderators to existing constructs in order to uncover new research.

Firstly, after reading the literature from Prakash & Das' (2022) literature review, we presented context to our research regarding COVID-19, DCT-applications, Smittestopp and personal data. Then, we elaborated on the different theories used in our study. These were Internet Users' Information Privacy Concerns (IUIPC), trust and risk beliefs, relative advantage and human emotions. After this, we put the theories together as constructs in a research model inspired by Lin et al. (2021), and proposed 9 hypotheses based on results from previous studies from the literature review. We then developed and distributed a questionnaire that got 189 respondents, which provided our study with quantitative data. From our questionnaire, we used a volunteer-system, where people could sign up for a follow-up interview, providing us with complementary qualitative data. We conducted and analyzed interviews with 11 candidates. We analyzed the questionnaire responses using SmartPLS, where we tested all our hypotheses. For the qualitative analysis, we used Quirkos, exploring significant mentions and quotes from transcripts of the interviews. From our quantitative study, all hypotheses were to

varying degrees supported. By using findings from our qualitative interviews, we complemented the quantitative results further by exploring contradictory and verifiable statements from the interviewees. The findings from the mixed methods approach are discussed next, comparing our newfound research and hypotheses with previous studies in which this thesis was fundamentally based on. A more thorough discussion of the research process as a whole can be read under [7.4](#).

7.2 Discussion of RQs and hypotheses

7.2.1 Research questions

Throughout the whole research process, our main goal was to explore and answer the following RQs: *“How do privacy concerns, trusting beliefs and relative advantage affect citizens' willingness to adopt contact tracing applications?”* and *“How do human emotions moderate citizens' willingness to adopt contact tracing applications?”*. To do this, we compiled all our analyzed data from the questionnaire and interviews, and discussed these against each of the 9 hypotheses as well as comparisons to earlier studies. Also, we interpreted each hypothesis's results based on newfound knowledge and insight as researchers.

7.2.2 Hypotheses discussion

The aim of our thesis was to answer two research questions. We conducted a survey with a questionnaire, thus collecting quantitative data that was used to test all 9 hypotheses. Our first two hypotheses (H1, H2) were developed to measure privacy concerns' effect on trusting and risk beliefs. Both were significant and had moderate path coefficient values. The third hypothesis (H3) was developed to measure trusting beliefs' effect on risk beliefs and was found to be significant and had a moderate path coefficient. We established that trusting beliefs, risk beliefs and relative advantage will affect a person's intention to use the Smittestopp-app and developed hypotheses to measure this (H4, H5, H6). H4 and H5 were significant and had path coefficients with a small effect while H6 was also significant but with a high path coefficient. Emotions also showed to play a role in a person's intention to use (Beaudry & Pinsonneault, 2010). Therefore, we also posited that emotions will have moderating effects on relations between risk beliefs and intention to use as well as relative advantage and intention to use (H7, H8). Emotions having a moderating effect means that if emotions increase in effect, a specific construct's effect on another construct also increases.

Naturally, we also hypothesized that peoples' intentions to use Smittestopp affected people into actually downloading and using Smittestopp (H9). H9 was significant and had a moderate path coefficient. With this, all hypotheses can be valued as supported/confirmed.

We aimed to see if our qualitative follow-up interviews could bring new knowledge into our existing quantitative data. Additionally, we wanted to see if the interview candidates could contribute by verifying what we already knew from the analyzed questionnaire data. The discussion of qualitative data is based on the presented findings of [6.2.3](#).

H1 Internet users information privacy concerns will have a negative effect on trusting beliefs

The quantitative analysis showed that hypothesis 1 is significant ($p < 0.01$), with a moderate path coefficient weight of -0.361 and a T-value of 3.076. Our qualitative data showed us that all interviewees had concerns about their privacy online, and that most would refrain themselves from using digital services if they were skeptical of the service. There were general privacy concerns amongst all our interviewees, with some of them specifying reasons such as hacks, breaches and leaks as main concerns. From our interviewees, we found that concerns about privacy made some services less trustworthy, such as Facebook, Google and even governmental services. This is in accordance with earlier studies, where privacy violations were shown to mediate trust and integrity towards the service negatively (Kumar et al., 2018; Martin, 2018). Based on what we now know, we think privacy concerns towards a service will highly decrease the chances of people using it, due to the lack of trust. Should this trust be broken, it will take a long time to rebuild it. Smittestopp aimed to reinvent itself to be more privacy friendly, however, people had already thrown the app aside after a catastrophic release that permanently reduced the trust of many Norwegians.

H2 Internet users information privacy concerns will have a positive effect on risk beliefs

The quantitative analysis showed that hypothesis 2 is significant ($p < 0.001$), with a moderate path coefficient weight of 0.434 and a T-value of 6.179. We can see from our qualitative analysis that all participants were aware of risks involved with sharing personal data, but took little to no steps to mitigate mentioned risks. Privacy concerns were almost exclusively tied to risks of having an online presence. With this, we see that privacy concerns do indeed affect a person's risk belief, but actual concern is rather low. We found that being the victim of hacking and leaks increased privacy concerns drastically, which in turn increased risk beliefs.

With all of this in mind, we think that a person's privacy concerns indeed affect their risk beliefs. However, concerns among most citizens are rather low due to not having faced any consequences of sharing their personal information online in the past. From previous studies, we also see that privacy concerns directly affected risk beliefs (Zhou, 2011; Hong & Thong, 2013).

H3 Trusting beliefs will have a negative effect on risk beliefs

The quantitative analysis showed that hypothesis 3 is significant ($p < 0.001$), with a moderate path coefficient weight of -0.445 and a T-value of 7.291. Our qualitative data showed us that trust in government led to the intention to use Smittestopp, while the risks by using it reduced the intention to use Smittestopp. Earlier studies have shown that increased trust in services makes people throw risk beliefs aside (Lin et al., 2021; Oldeweme et al., 2021). From our newfound insight, we now believe trust and risk to be opposites in many ways. We can also back this statement up by looking at H1 and H2, where UIPC reduced trust beliefs but increased risk beliefs. Had we hypothesized the interaction the other way around, risk beliefs by using digital solutions would almost certainly have reduced trust in said services.

H4 Risk beliefs will have a negative effect on intention to use the Smittestopp-app

The quantitative analysis showed that hypothesis 4 is significant ($p < 0.05$), with a small path coefficient weight of -0.124 and a T-value of 2.213. We asked all our interviewees if they would have used Smittestopp had it been riddled with more privacy risks. Most of them said no, while the rest told us that they would not have used the application anyway, giving us a clear indication that risk impacts intentions to use negatively. Our findings can be compared to several other studies that found risk concerns to negatively impact intention to download and utilize DCT-applications (Hassandoust et al., 2021; O'Callaghan et al., 2021; Duan & Deng, 2021). Aligning our findings on risk beliefs with privacy risks, performance risks and social risks (Oldeweme et al., 2021), we see that our data does not give people with risk beliefs any good reasons to adopt Smittestopp. People with privacy risk beliefs will fear for their personal data by using the app, while those with performance risk beliefs will dislike the lack of functionality and battery drainage. Social risk beliefs can be interpreted in different ways, where some might feel the need to download it because "everyone else did it". However, our research might indicate that the opposite did in fact happen. People refused to download the application because none of their friends or families did it.

H5 Trusting beliefs will have a positive effect on intention to use the Smittestopp-app

The quantitative analysis showed that hypothesis 5 is significant ($p < 0.05$), with a small path coefficient weight of 0.148 and a T-value of 2.212. Information gathered from our qualitative data suggests that trust in government especially affects the intention to use Smittestopp. Almost all participants said that they would not even consider using Smittestopp at all if it was owned by a private organization. Trust in this context can be many things. Trust in who owns and develops the service one intends to use is the most prevalent in our research. Trust is also hard to achieve, and as such, is hard to measure. This could be the reason for the low effect from the quantitative analysis. We believe that trusting beliefs do affect a person's intention to use Smittestopp, but trust in the Norwegian government is the driving factor here. Previous studies show that lack of trust in government has far reaching consequences and indeed affects peoples' intentions to install a DCT app (Altmann et al., 2020; Prakash et al., 2021).

H6 Relative advantage will have a positive effect on intention to use the Smittestopp-app

The quantitative analysis showed that hypothesis 6 is significant ($p < 0.001$), with a strong path coefficient weight of 0.781 and a T-value of 16.426. Several interviewees told us that Smittestopp was a flawed digital solution with privacy risks and lacked optimal functionality. However, most of our interviewees agreed that if the app had worked perfectly to its intentions, it would have been highly advantageous for the population. These advantages would lead to more people actually using the application. Lin et al. (2021) garnered the same results, where relative advantage strongly increased intention to use COVIDSafe in Australia. The reason why relative advantage increased intention to use is undoubtedly the positive outcomes of advantages and digital innovation. None of the individuals whom we spoke with disagreed that clear advantages would make people download and use the app.

H7 Negative emotions moderate the relationship between risk and intention to use

The quantitative analysis showed that hypothesis 7 is significant ($p < 0.01$), with a small path coefficient weight of 0.102 and a T-value of 2.629. Data from our qualitative analysis confirmed this with fear being a prevalent emotion mentioned in regards to risks like information leaks and hacking. Fear of being tracked was also a recurring statement. Fear is a strong emotion, and we believe it is the main reason as to why some people have stronger risk beliefs. This negatively impacted the intention to use Smittestopp, as fear of being tracked or having one's information leaked would prevent them from downloading Smittestopp initially.

Similarly, another study found a link between perceived fear of COVID-19 and intention to use DCT-applications (Alsaad & Al-Okaily, 2021). This is not something we picked up on before conducting interviews. When analyzing the interviews, we realized that fear was a very determining factor regarding reluctance to adopt DCT-apps.

H8 Positive emotions moderate the relationship between relative advantage and intention to use

The quantitative analysis showed that hypothesis 8 is significant ($p < 0.01$), with a small path coefficient weight of 0.114 and a T-value of 2.963. Our qualitative interview data showed us that people were generally not happy with Smittestopp, thus, not having any positive emotions towards it. People stated that the app had its clear advantages, but people were not happy with its execution. These qualitative insights contradict our quantitative questionnaire analysis. However, had the application been rid of faults and privacy concerns from the beginning, we believe people would have been much more positive towards the app. These positive emotions would likely moderate the relationship between relative advantage and intention to use, as positive emotions have been shown to increase perceived benefits in the past (Ding & Chai, 2015).

H9 Intention to use will have a positive effect on downloading and using the Smittestopp-application

The quantitative analysis showed that hypothesis 9 is significant ($p < 0.001$), with a moderate path coefficient weight of 0.421 and a T-value of 6.993. Our qualitative data showed us that all the interviewees who intended to download and use the app, actually did. It is worth noting that most of these people, at one point, uninstalled the application as well. Intention to use has been found to increase use in earlier studies (Oldeweme et al., 2021; Tao, 2009). We believe that the effort of downloading an application nowadays is so miniscule, meaning that everyone who thought about downloading Smittestopp did it effortlessly within a couple of minutes. Had the application demanded more effort in setting it up, the positive relation between intention to use and actual use might have been less significant.

7.3 Discussion of other findings

Our mixed methods research has shown both expected and unexpected results. We found all our hypotheses to be supported based on the analysis from the questionnaire, with verifying data based on follow-up interviews. However, we have also uncovered other findings that

were interesting to discuss. From our questionnaire, we found that older citizens had a lower percentage of downloads of Smittestopp, with the age group of 45-54 being the one with the lowest mean. The mean of the 45-54 age group was 0.25. This is much lower than the younger age group 25-34 which has 0.64. Our interviews had contradictory results, where everyone in the older half had downloaded the app, and everyone in the younger half did not download the app. This can be a total coincidence as the interview sampling consisted of volunteers from the questionnaire, but should still receive some attention. Older interviewees showed more knowledge about the application and its functionalities as well. We interpreted this as the older generations being more concerned with consequences of spreading COVID-19, and as a result being more informed on digital contact tracing methods through media channels.

The interviews also showed that some participants wished Smittestopp was more heavily enforced. One interviewee who had used other DCT-apps while traveling abroad, saw a clear contrast between nations forcing citizens to use a DCT-app and nations who did not. Nations that had enforced DCT-apps saw a much greater benefit from our interviewee's perspective. All our interviewees had either uninstalled or deactivated Smittestopp as of speaking to them.

The functionality of Smittestopp depended on a higher percentage of users actually adopting it. Because of this, the app was regarded as a failed digital solution in the eyes of many of our candidates. We believe that Smittestopp would have been more effective if it was mandatory to download and activate it early on. However, this would come at the cost of freedom of citizens, which was considered a negative consequence to some of our participants. Enforcing the app in order to gain effective results would undoubtedly have met resistance from many.

Many of the non-adopters in our study declared laziness as a determining factor for not downloading Smittestopp. Downloading and using the app on their smartphone was considered a bother for many, and these people chose to resort to the public corona phone number when registering infection instead. We believe the lack of enforcement and the media criticism of Smittestopp gave citizens few reasons to willingly adopt the DCT-application.

7.4 Discussion of research process and work progression

Planning

The second year of Information Systems at the University of Agder is divided into two semesters. The first semester focused on preparing ourselves for the second semester, the master's thesis. This meant that the planning phase started as early as autumn 2021. From the first semester, we knew that we wanted to explore how people perceive their personal information, and what they know about personal data collection. We also gained valuable experience on finding literature, as well as how to conduct qualitative interviews. By having regular meetings with our supervisor, we eventually started looking at calls for research on post-COVID related topics. Thus, we merged our existing passion for personal data collection with COVID-related research, and started looking at studies on digital contact tracing (DCT). If we had not used the planning phase as efficiently as we did, we would not have reached all our goals within the given timeframe.

Literature review and research model

We started looking at several studies that focused on DCT-applications and how these could be put into a systematic literature review. However, most of the articles we had found were already featured in a thorough literature review developed by Prakash & Das (2022). By adopting their literature review for our thesis, we saved a lot of time, as all of these studies were recent studies relevant to our research motivation. Their literature review consisted of 18 studies, and we added 6 more to it as we considered them beneficial for our study. We relentlessly aimed to see how these studies could be used from a Norwegian perspective, and found that the study of Lin et al. (2021) focused on citizen's willingness to adopt the Australian COVIDSafe app. Having had experience with the Norwegian DCT-app, Smittestopp, we borrowed their research model and adjusted it for our research based on recommendations from our supervisor. Eventually, we had several theories and constructs, as well as a research model to focus on. With the inclusion of human emotions as a moderating effect, we were confident that our research would discover new aspects of the recent research area of DCT-applications. We also realized that our research could relate to situations beyond the pandemic, and that many organizations can learn from how DCT-applications were distributed to the public as a product.

Data collection

Based on influential conversations with our supervisor, we thought it best to start with a quantitative approach when collecting empirical data for our study. We knew that the quantitative distribution of a survey would result in us collecting large amounts of data much quicker, especially as we borrowed some of the survey questions from Lin et al. (2021). We distributed our survey questionnaire to friends and family first, as they could provide us with immediate feedback. The questionnaire was perceived as confusing and complicated, and based on feedback made it much more approachable before distributing it publicly. It was distributed through emails, social media sites such as Facebook and LinkedIn, and Norwegian community platforms such as Reddit (r/Norway) and Discord. A large number of people opened the survey, though 189 individuals completed it fully.

In order to explore the interest of potential qualitative complementary research, we informed our participants of a follow-up interview, giving them an opportunity to sign up if interested. A total of 13 people were interested, and thus, we developed an interview guide based on the early findings of the quantitative data. Combined, both of us knew these 13 people personally, and in order to hinder any potential bias by picking who to interview, we interviewed all of them. We used semi-structured interviews, as most of the candidates had different experiences regarding Smittestopp and perceptions on personal data. We used the Nettskjema-dictaphone application from the University of Oslo to ensure encrypted recordings. These recordings made it possible to transcribe our interviews using intelligent verbatim transcription methods, capturing every essence of responses without filler words and noises. Unfortunately, the Nettskjema-dictaphone application had some issues, resulting in 2 of our interviews being corrupt save files and lost forever, ultimately giving us 11 interviews to garner data from.

Analysis and findings

In order to use time efficiently, we divided the work amongst ourselves. Tord was given the main responsibility of analyzing the questionnaire data, while Christian was collecting the relevant theory and wrote most of the report. The quantitative data was analyzed using SmartPLS, where we tested the constructs and hypotheses using different validity and reliability functions within the software itself. From SmartPLS, we found that all our hypotheses were supported based on the survey responses, however, several of them were only barely supported. For this reason, the qualitative interviews became a much more vital part of the study, as we could use the findings from our interviews to further complement the

quantitative questionnaire findings. We split the interviewees among the two of us, in order to save even more time, and fittingly transcribed our own interviews afterwards.

When looking to analyze the qualitative interviews, we specifically looked for cloud-cooperation software, so that we would not have to divide our work as we did when using SmartPLS. We found Quirkos based on recommendations from our classmates, and this software allowed us to analyze transcripts together in real-time and provided us with a visualized interface which we could generate analysis reports from. The data from our 11 interviews gave us a whole new perspective on the research area, and complemented our findings from the questionnaire in several ways. This resulted in discovering other findings outside our predetermined constructs and hypotheses, which we valued as interesting insight on the research topic.

Writing a conference article

After having finished the analysis of the quantitative part of our study, we were approached with a proposal from our supervisor. He gave us the opportunity to publish a draft of a 12-page article, focusing on what we had researched thus far. The conference was the 21th IFIP Conference: e-Business, e-Services, and e-Society (I3E2022). Gratefully, we collected the findings from the analyzed questionnaire, and developed a draft of an article during Easter break 2022. Writing this article was completely optional on our end, but we still wanted to pursue this with hopes of getting valuable feedback despite whatever the outcome would be. Unfortunately, the deadline was pushed to May, so we did not get feedback before this thesis was delivered. The experience of producing a research article was very interesting and valuable nonetheless.

Discussion and finishing the project

After Easter, we were done with analyzing the questionnaire data as well as writing the article for I3E2022. We had made good progress with our interviews, and analyzed these through Quirkos shortly after. Since we now had all the data we needed, we could spend the last month efficiently, and spend a good amount of time writing this report as well as comparing our findings against previous aforementioned studies. After discussing our findings, as well as giving recommendations for future studies, we fixed the thesis based on valuable feedback from our supervisor. The foreword, abstract and conclusion were finished last. Being able to write a master's thesis on a research area we were genuinely interested in has given us

experience we will value for a long time, and we are grateful for all the help we received from our supervisor, questionnaire participants, interviewees, friends and family. Lastly, this thesis was delivered on June 1st, 2022.

Work progress

In order to visualize the progression of our work, we made Table 16. Here, the different action plans within the development of our master’s thesis are presented, along with the timeframe in which these actions were performed.

Table 16 - Progression of work activities.

Action Plan	January	February	March	April	May	June
Meetings with supervisor	X	X	X	X	X	
Exploring research areas	X					
Find relevant literature	X	X	X			
Adopt research model		X				
Define research questions		X				
Propose hypotheses		X				
Develop survey questionnaire		X				
Questionnaire data collection		X	X			
Analyze questionnaire data		X	X	X		
Develop interview guide			X	X		
Interview data collection				X	X	
Analyze interview data				X	X	
Write conference article (I3E2022)				X	X	
Write master’s thesis report	X	X	X	X	X	
Deliver the master’s thesis						X

7.5 Limitations and challenges

This research study and master’s thesis suffered from some shortcomings and limitations, as with every empirical study. In this section, we present the following limitations as well as some challenges that slightly hindered our research process.

7.5.1 Limitations of study

We confined our study within the research area of online privacy and personal data collection. This means that all of the individuals partaking in our online questionnaire have already shown signs of being willing to share their thoughts and opinions, albeit anonymously, on the internet. We could have worked around this by also handing out the questionnaire in paper-format, but this would have taken up much more time and resources in terms of securing anonymity and data analyzing, and in a mixed methods study, this was not an option.

Also, we aimed to share the questionnaire publicly through social media, excluding many people who do not normally use these (Facebook, LinkedIn, Snapchat etc.). In order to reach out to even more people, we used online communities such as Reddit and Discord channels. Afterwards, we saw a notable boost to the amount of respondents. However, we still only garnered respondents already exposed to online behavior and typically young adults. If we had more time, we would have explored other methods in order to reach a broader audience.

When it comes to the questionnaire contents itself, we got a lot of early feedback that the questions were complicated and not easily comprehensible, resulting in certain individuals skipping them (more specifically just choosing a random option). As the early version of our survey was distributed to mostly close friends and family, we were contacted directly by them and improved our questionnaire accordingly. However, despite these improvements, we occasionally got some feedback from people who needed further explanation on the questions.

The questionnaire was completed by mostly younger Norwegians, with 70,4% being under 35 years old (see [6.1.1](#) for questionnaire data demographics). Also, we believe that a good amount of our respondents were residents of southern Norway, as this is where we have most contacts. If given more time, we could have explored different parts of Norway in order to look at behavioral differences towards digital solutions based on geographics. Another limitation is the relatively small sample size. To compensate for this, we used follow-up interviews to complement the data from the questionnaire responses.

We also encountered some limitations with our interviews. As our list of interviewees consisted entirely of people who participated in our questionnaire, the demographic sampling was plagued with the same limitations as the questionnaire, mostly having young adults as interviewees. We further explored the opinions of those who had already contributed to our questionnaire, thus, not collecting data from a new sample. Also, we did not anticipate the questionnaire respondents who wanted to do interviews, making the interview sample random based on voluntariness.

7.5.2 Challenges

Though we might have had some limitations to our research study, we fortunately did not stumble upon any major challenges. Whenever we had any roadblocks or problems, we got

almost immediate feedback from our supervisor on what to do to resolve any issues. Both authors and supervisor were also infected with COVID-19 at different times throughout the semester, halting some of the progress being made. This was not a big issue, as we are well-versed in working remotely using digital solutions. Our biggest problem, however, was the fact that two of our conducted interviews were lost forever due to corrupt save files. Through Nettskjema, interviews were not locally saved on our phones, but rather sent to their encrypted browser site. Unfortunately, this did not work for these two interviews. Due to potential bias, we did not conduct additional interviews with these candidates.

When transcribing interviews, we also faced another problem. The initial program we wanted to use, NVivo, did not have cloud cooperation unless you paid a relatively high price. As cooperation had been such a vital part of this thesis, we had to find a suitable replacement. Thankfully, Quirkos had a free trial, with mostly the same functionalities as well as an interface focusing on visualization. It was also somewhat challenging to translate fully Norwegian interviews to English words when analyzing qualitative data. Based on our experience, one Norwegian word can have a lot of different meanings, while the English language usually has one word for every single little thing. Thus, we had to interpret Norwegian to the best of our efforts when developing this thesis, and we are very confident with the results.

Handling several aspects of the research simultaneously was also considered quite challenging. Most of the time, we were analyzing data, collecting data and writing this report all at the same time. Although, this was to be expected when developing a mixed method research. Additionally, we got a proposition from our supervisor to create a full 12-page article for the 21st IFIP Conference on e-Business, e-Services, and e-Society (I3E2022). This article was based on the quantitative research that had been done first in this thesis, and was developed while we were collecting qualitative data during Easter 2022. This meant that we had to spend quite a bit of time on extra work not directly included in this thesis, but gained valuable experience. We are confident that we handled all the challenges as best we could.

Despite a few limitations and some occurring challenges during our research, the study brings several clear implications for research practices and future work.

7.6 Implications and future work

In this study, we have attempted to explore and understand Norwegian citizens' willingness to adopt DCT-applications. More specifically, we focused on Smittestopp and how privacy concerns, trusting beliefs, relative advantage and human emotions affected the desire to adopt said application. Having adapted the research model from Lin et al. (2021) and modified it by including the moderating effects of human emotions (Pappas et al., 2016), we have contributed with new knowledge and insight to the call for research on DCT-apps. This newfound knowledge provided us with several implications for research.

7.6.1 Implications

Implications for research

The findings of our study can be aligned with similar findings from Lin et al. (2021), as every hypothesis we adopted from their study was supported. Most significantly, relative advantage was perceived by Norwegians to highly increase intention to use Smittestopp, to the same degree as Australians did with COVIDSafe (Lin et al., 2021). This implies that despite the long global distance between the countries, research has shown that Norwegians' and Australians' perceptions on adopting DCT-applications are very much alike. Unique to our study, we used positive human emotions to moderate the relation between relative advantage and intention to use, which resulted in even more significant results. This gave clear implications that positive emotions can be used in research to strengthen the relationship between constructs, which it indeed did for our study based on two supported hypotheses (H6, H8). Also, risk beliefs negatively impacted intention to use, which was not the case for Lin et al. (2021). This could imply that Norwegians' are more aware of risks and consequences of using DCT-applications. Another plausible reason might be the moderating effects of negative human emotions used to moderate the relation between risk beliefs and intention to use. These implications support previous studies where risk beliefs negatively influenced the adoption of DCT-apps (Hassandoust et al., 2021; Duan & Deng, 2021), in some cases to protect communities and others (O'Callaghan et al., 2021). Our findings also strengthen studies where negative emotions have impacted the use of new systems (Zheng & Montargot, 2021).

We deem the use of positive and negative emotions from Pappas et al. (2016) as successful contributors to our study, and could have further uses within research on DCT-applications. Since the initial outbreak of COVID-19, individuals experienced huge amalgamations of

thought processes and emotions due to big changes financially, physically and to the society. (Choudrie et al., 2021). Our research implies that emotions regarding users' information privacy concerns and Smittestopp are results of these sudden outbursts of feelings originating from the pandemic. Positive and negative emotions were shown to influence intention to use in different scenarios, and thus, our study participants must have had predetermined opinions and concerns. These opinions likely formed or became clearer due to the pandemic, and the experience people now have with DCT-applications might change the perceptions on digital services and solutions in the future. For research, addressing these emotional developments should be interesting, and one could implement more underlying human factors into studies on DCT. Semi-structured interviews provided interesting discussions through human interaction that other researchers should also utilize on the topic of DCT, as the answers could reveal more than a predetermined questionnaire.

Implications for practice

Our study can also contribute to several practices outside research. For instance, our findings help enlighten and prepare both organizations and individuals for similar situations. Studies have shown that there is an increased likelihood of new waves of COVID-19 (Osuchowski et al., 2020; Zawbaa et al., 2022). The Norwegian government can look to this study for reasons as to why Smittestopp was not generally used by the younger generation. They can use the experience they have from 2020-2022, as well as the findings from this research, to plan ahead and develop an application that can more accurately detect and trace infection spread. In order to increase intentions to use the application, the government needs to deliberately increase trust towards governmental digital services amongst the population, and reduce obvious risks. Also, as incentives have caused people to self-disclose personal information previously (Bansal & Nah, 2020), governments could incorporate incentives to use DCT-apps to increase willingness.

Proposing clear advantages by using the service should also be prioritized. Relative advantage was the most significant reason for people to adopt both Smittestopp and COVIDSafe, so the Norwegian government should aim to make the advantages of DCT-applications more visible. As we found, these advantages would be moderated by positive emotions.

The recent pandemic is one example of why it is important to be well-prepared with digital solutions. The uncertainties of unpredicted major crises should be a focus point for many

digitalized governances, as mitigated risks and consequences may eventually save lives. We firmly believe that being prepared with digital solutions is important. Previous experiences, for instance Smittestopp in Norway, should be investigated and improved upon in order to make future potential catastrophes less severe. One must expect the unexpected.

Other organizations and companies can also look to this research when releasing an application or digital service to a larger population. Our findings based itself on questions regarding personal data, and what it takes for people to share their personal information to digital services; both governmental and private. Our research implies that governmental and private organizations must be mindful of privacy concerns when releasing a digital service, as trust takes a long time to achieve by consumers. Should this trust be broken, it can take a long time to regain it, if possible at all.

7.6.2 Recommendations for future work

Though we explored new insight and knowledge to this recent research area, there is still much more to discover for other researchers. When it comes to Norway in particular, one could research a sample within designated geographic locations, for instance Oslo. Our survey included a large spread of Norwegians, where several individuals originated from smaller municipalities where COVID-19 spread was less prevalent. It would be interesting to see the perceptions on Smittestopp in a more densely populated area. Researchers should also adopt a mixed methods approach, as this has provided us with more interesting results beyond a predetermined set of questions and metrics. In order to include a more diverse sampling, the researchers could account for digital divide by presenting questionnaires in paper-format. Contrarily, they could also conduct interviews digitally instead of face-to-face like we did, eliminating travel time and increasing the reach of who they can converse with.

Outside Norway, we encourage researchers in other countries to continue to use our research model, refining it if needed. This is in order to unveil similarities and differences of people with other nationalities. The way individuals' perceive technology, digital services and DCT-applications can differ drastically based on geographical locations, backgrounds and culture (Choi et al., 2018). From our sampling, we found that Norwegians and Australians perceived DCT-applications and personal data in very similar ways, so it would be interesting to compare these results to findings from other countries. One should also be mindful of the development of COVID-19 and adjust research accordingly. Thus, in the same vein as Lin et

al. (2021), we declare a further call for research on citizens' willingness to adopt DCT-applications.

To sum up the recommendations for future researchers, we made some bullet points as reference:

- Use and refine the research model used in this study.
- Explore other human factors as well as human emotions.
- Continue to utilize mixed methods, particularly a survey with questionnaire and follow-up interviews.
- Account for everyone, even those without/refusing technology.
- Aim for a larger sample. Consider focus groups, e.g. geographically or age groups, then potentially compare findings from the different focus groups.
- Adjust research accordingly based on the pandemic situation. Based on newfound implications, this research is not limited to COVID-19 alone, and can be used for similar major crises in the future.

Should other researchers follow these recommendations, new knowledge on adoption of DCT-applications could be uncovered. This knowledge could collectively contribute to a better understanding of citizens' willingness to share personal data to DCT-applications, and help governments and organizations to enhance their services. This, in turn, could benefit the population as a whole, and possibly save countless lives depending on the situation. One can only speculate how many lives could have been saved if Smittestopp was a perfect DCT-app used by everyone in Norway from day 1.

8. Conclusion

The aim of this mixed methods study was to explore Norwegian citizens' willingness to adopt the digital contact tracing (DCT) application, Smittestopp. To do this, we proposed the following research questions (RQs): “*How do privacy concerns, trusting beliefs and relative advantage affect citizens' willingness to adopt contact tracing applications?*” and “*How do human emotions moderate citizens' willingness to adopt contact tracing applications?*” These RQs were answered with data collected from a survey with a questionnaire consisting of 189 responses from Norwegian citizens. This data was then analyzed using Partial Least Squares Structural Equation Modeling (PLS-SEM) with the software tool SmartPLS. To complement this, a round of follow-up interviews were conducted as well. The data from the transcribed interviews were analyzed and structured using Quirkos; a Computer-assisted Qualitative Data Analysis Software (CAQDAS). The analyzed questionnaire and follow-up interviews were then used to test the hypotheses.

An existing systematic literature review was expanded upon prior to the analysis, to uncover knowledge upon the research area. We found that a call for research on adoption of DCT-applications was requested by Lin et al. (2021), who had done research on Australian citizens' willingness to adopt COVIDSafe in Australia. Their research model was adopted and adjusted for our study, with the inclusion of human emotions as moderating effects.

Our analysis of the questionnaire showed support for all our hypotheses to varying degrees. The path coefficient weights varied in strength, but were later complemented by data from follow-up interviews. We concluded that privacy concerns, trusting beliefs, risk beliefs and relative advantage all have an effect on a Norwegian citizen's intention to use Smittestopp. We found that privacy concerns influenced risk positively and trusting beliefs negatively, which in turn affected their willingness to adopt Smittestopp. Relative advantages of using DCT-apps significantly increased the willingness to adopt it. Negative emotions moderated risk beliefs and positive emotions moderated relative advantage into intentions to use.

This thesis contributes to existing research on adoption of DCT-applications. Governments and organizations can refer to this study in order to investigate peoples' willingness to adopt future digital solutions. By learning from our analysis of privacy concerns and human emotions, one could potentially mitigate damage and deaths caused by future major crises.

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Appendices

Appendix A - Literature review

Literature review conducted by Prakash & Das (2022):

Author (year)	Objective/Context	Methodology	Theory	Results/Findings
Altmann et al. (2020)	Potential user's acceptance of DCT app	Quantitative survey, Multivariate regression analysis	NIL	The main impediments to adoption are concerns about security and privacy and a lack of trust in the government.
Walrave, Waeterloos, and Ponnet (2020)	Factors influencing DCT app usage intention among potential users	Quantitative Survey, SEM	HBM	Perceived benefits, self-efficacy, perceived barriers, and cues to action predicted app use intention. Perceived severity and perceived susceptibility were not related to use intention.
Trang, Trenz, Weiger, Tarafdar, and Cheung (2020)	To examine how app specifications influence DCT app installation intention	Experimental, OLS, and Quantile regression	Prosocial behavior, privacy, and usability	Self-benefit appeal, self-societal-benefit appeal, high privacy design, high convenience design influence DCT app installation intention.
Sharma et al. (2020)	Factors that influence DCT app use intention among potential users	Quantitative Survey, SEM	DC theory, PFT, PMT, TPB, and CDT	Attitude, subjective norms, and privacy self-efficacy predict DCT app use intention. Privacy concerns, expected personal and community-related outcomes of sharing information determine attitude towards the DCT app.
Hassandoust, Akhlaghpour, and Johnston (2021)	To develop a model for explaining potential users' privacy concerns and intention to install a DCT app	Quantitative Survey, SEM	PCT, Risk beliefs	Risk beliefs, contact tracing benefits (individual and societal), personal innovativeness, voluntariness, perceived effort, social influence, and age influences intention to install a DCT app.
Saw et al. (2021)	To identify the factors associated with the voluntary download of a DCT app	Quantitative Survey Logistic regression	NIL	Using hand sanitizers, avoiding public transportation, and preferring outdoor over indoor settings during pandemic were related to DCT app download. However, neither demographic nor situational factors were significantly associated with app downloads.
Kaspar (2020)	To examine factors determining the motivation for using the DCT app	Quantitative Survey, Multiple regression	PMT and Social trust	Self-efficacy, response efficacy, response cost, severity and vulnerability of data miss-use, and trust in the app were associated with motivation for using the DCT app.
Walrave, Waeterloos, and Ponnet (2021)	Factors that influence DCT app use intention among potential users	Quantitative Survey, SEM	Extended UTAUT	Performance expectancy, facilitating conditions, social influence, innovativeness, and privacy concerns predicted use intentions. Effort expectancy was not related to intention.
Blom et al. (2021)	To investigate barriers to the adoption of the DCT app	Qualitative Survey, Descriptive	NIL	Inability to install apps/activate Bluetooth, lack of access (to a smartphone, compatible OS), and lack of willingness (to use, to go into

				quarantine, to test or report results etc.) were identified as the major barriers.
Lin et al. (2021)	Factors influencing willingness to download a DCT app	Qualitative Survey, SEM	DOI theory	Relative advantage, compatibility, and trusting beliefs increase adoption intentions.
O'Callaghan et al. (2021)	To examine barriers and drivers to the use of a DCT app	Qualitative Survey, Descriptive	NIL	Protection of family and friends, responsibility to the community, knowing the risk, reducing the deaths, etc. were the reasons for and concerns about surveillance, risk of hacking, concerns about disclosing information about location/people in contact, difficulty in installation, etc. were reasons against the use of DCT app.
Tomczyk et al. (2021)	To test and compare the validity of technology acceptance models in predicting DCT app adoption intention and use	Quantitative Survey, Hierarchical regression	TPB, and UTAUT2, Privacy	Adoption intentions (R2 = 56–63%) and frequency of current app use (R2 = 33–37%) were predicted by the TPB and UTAUT2 models. A combined model including privacy concerns and anticipatory anxiety improved the predictive value by around 5%.
Fox et al. (2021)	To investigate the impact of privacy, social and benefit perceptions on DCT app acceptance.	Quantitative longitudinal two-stage survey, SEM	PCT and SET	Social influence, reciprocal benefits, health benefits predict pre-launch adoption intention. Privacy concerns, reciprocal benefits, and pre-launch adoption intention predict post-launch usage intention.
Duan and Deng (2021)	Investigates the factors influencing adoption of DCT app	Quantitative Survey, SEM, and ANN	UTAUT and PCT	Effort expectancy, the value of information disclosure, and social influence predict adoption intention. Performance expectancy and privacy risks indirectly influence the adoption via the value of information disclosure. The effect of facilitating conditions on adoption intention is insignificant.
Touzani et al. (2021)	Evaluate the acceptability of the DCT app and investigate the barriers to use	Quantitative Survey, Multinomial logistic regression analysis	NIL	Only 19.2% supported the app use. Lower financial deprivation, perceived usefulness, trust in political representatives, concern about the pandemic situation, knowledge about the COVID-19 transmission, and age were associated with the willingness to use the DCT app.
Tretiakov and Hunter (2021)	Investigate factors driving the use of the DCT app and the experience of using it	Qualitative interviews, Thematic analysis	NIL	Identified five major themes perceived benefits, patterns of use, privacy, social influence, and need for collective action.
Trkman, Popovic, and Trkman (2021)	To examine the influence of perceived crisis severity and perceived benefits on intention to use DCT apps	Quantitative Survey, SEM	CDT	The findings support the impact of perceived crisis severity on DCT app use intention and the mediating impacts of personal and social benefits on this relationship
Prakash et al. (2021)	To explore the factors that determine individuals' intentions to continue using the DCT app.	Quantitative Survey	ECM	User satisfaction, trust in government, and trust in technology are all major determinants of individuals' intention to continue using the DCT app. User satisfaction is influenced by perceived security and privacy and trust in technology.

Appendix B - Questionnaire

General

Q1: What age group do you belong to?

Q2: What is your sex?

Q3: What is your highest level of education?

Q4: What is the population of your municipality?

Q5: Do you own a smartphone?

Q6: Have you used the Smittestopp application during the COVID-19 pandemic?

Q7: Are you in a risk group, or in close contact with someone that is in a risk group?

Q8: Do you regularly turn off your phone's functionalities when you don't need them?

From here on, we used a 7 point Likert Scale for each question.

(strongly disagree, disagree, slightly disagree, neutral, slightly agree, agree, strongly agree)

Awareness

Q9: The Norwegian government seeking information online should disclose the way the data are collected, processed and used.

Q10: A good consumer online privacy policy should have a clear and conspicuous disclosure.

Q11: It is very important to me that I am aware and knowledgeable about how my personal information will be used.

Control

Q12: Citizen online privacy is really a matter of consumers' right to exercise control and autonomy over decisions about how their information is collected, used and shared.

Q13: Citizen control of personal information lies at the heart of consumer privacy.

Q14: I believe that online privacy is invaded when control is lost, or unwillingly reduced as a result of marketing transactions.

Collection

Q15: It usually bothers me when the Norwegian government asks me for personal information online.

Q16: When the government asks me for personal information, I sometimes think twice before providing it.

Q17: It bothers me to give personal information to so many Norwegian government agencies.

Q18: I'm concerned that the Norwegian government collects too much personal information about me.

Trust

Q19: The Norwegian government would be trustworthy in handling Smittestopp information from the Smittestopp app.

Q20: The Norwegian government would tell the truth and fulfill promises related to (my information) provided by me.

Q21: I trust that Norwegian government would keep my best interests in mind when dealing with my information

Q22: The Norwegian government, in general, is predictable and consistent regarding the usage of my information.

Q23: The Norwegian government is always honest with citizens when it comes to using my information that I provide.

Risk

Q24: In general, it would be risky to give my information to the Smittestopp app.

Q25: There would be a high potential for loss associated with giving my information to the Norwegian government.

Q26: There would be too much uncertainty associated with giving my information to the Norwegian government.

Q27: Providing the Norwegian government with my information would involve too many unexpected problems.

Q28: I would feel safe giving my information to the Norwegian government.

Relative benefits/advantage

Q29: Downloading Smittestopp enhances the Norwegian government's effectiveness with contact tracing.

Q30: Downloading Smittestopp improves the quality of contact tracing.

Q31: Downloading Smittestopp enables the Norwegian government to trace coronavirus cases more quickly.

Q32: Overall, I find downloading Smittestopp would be advantageous for contact tracing.

Download and usage

Q33: It is worth it to download Smittestopp.

Q34: I will strongly recommend others to download Smittestopp.

Q35: Downloading and using the Smittestopp application makes me feel:

Pleasure	Amusement	Admiration
Joy	Interest	Love
Pride	Contentment	Relief
Anger	Fear	Guilt
Hate	Disappointment	Sadness
Contempt	Shame	Compassion
Disgust	Regret	

(Each emotion: strongly disagree, disagree, slightly disagree, neutral, slightly agree, agree, strongly agree)

Appendix C - Interview guide

Relative advantage

- Have you downloaded Smittestopp during the course of the pandemic? Why/why not?
- Do you think there are more pros than cons by downloading/using Smittestopp?
- Do you feel digital solutions like Smittestopp are helpful in fighting a global crisis like the pandemic?
- What do you think is the reason for the low usage of Smittestopp in Norway?
- Do you think there could be better digital solutions than Smittestopp to fight infection spread?

Awareness

- How aware do you feel you are, when it comes to how your personal information is being used online?
- Do you know any corporations/companies that collect personal information? What do you think about this?
 - Do you know what they use your personal information for, and what do you think they use it for?
- Do you regularly update yourself on how your information is being collected and handled online? Why/why not?

Trust

- How much trust do you have in various information collectors (e.g. Norwegian state or private organizations such as Facebook, etc.)?
- What is it that gives you more or less confidence in the various mentioned?
- Are there any organizations you trust more than others? Why / why not?
- Do you feel that the state and / or other organizations are transparent and good at showing what they actually use your personal information for?
 - What does it take for you to trust a website / application?
- Are the people you associate with aware of this to the same degree as you?
 - Do you know anyone who distances themselves from the internet / social media due to awareness of personal information? Someone who has a lot of trust?

Risk

- Do you feel there is any risk involved in sharing your information online? Why / why not?
- Do you work to reduce risk in relation to your personal information?
- Is there anything that can make you more confident in sharing your information online?
- Are there any cases where you have felt it was too risky to share your information with a new platform or service? Why / why not? Did it make you not engage with the platform / service?
- Are you afraid that personal information about you will get lost? (get leaked from eg social media)

Control

- Is it important for you to have control over your personal data? Why / why not?
- Are there one or more reasons why you need / do not need control over your personal information online?
- What would you do if information about you had been leaked?
- What do you think about privacy laws and how they help protect you online?

Collection

- Do you mind sharing your personal information online? Why / why not?
- Are you thinking about and considering whether to share your information online?
- Do you feel like someone is asking for too much personal information online? For example cookies
- Have you ever stopped using a website or app for them to collect your information?

Appendix D - NSD approval

(Project was in very early development at this time, some details, like project title, differ)

Referansenummer

478451

Prosjekttittel

Mennesker sin oppfatning av personlig datainnsamling etter COVID-19, og hvordan disse oppfatningene påvirker digital sikkerhet og tillit (Foreløpig tittel)

Behandlingsansvarlig institusjon

Universitetet i Agder / Fakultet for samfunnsvitenskap / Institutt for informasjonssystemer

Prosjektansvarlig (vitenskapelig ansatt/veileder eller stipendiat)

Ilias Pappas, ilXXXXXXXX@uia.no, tlf: 48XXXXXX

Type prosjekt

Studentprosjekt, masterstudium

Kontaktinformasjon, student

Christian Ødeskaug, caXXXXXX@uia.no, tlf: 41XXXXXX

Prosjektperiode

10.01.2022 - 03.06.2022

Vurdering (1)

06.01.2022 - Vurdert

Det er vår vurdering at behandlingen av personopplysninger i prosjektet vil være i samsvar med personvernlovgivningen så fremt den gjennomføres i tråd med det som er dokumentert i meldeskjemaet med vedlegg den 6.1.2022. Behandlingen kan starte.

DEL PROSJEKTET MED PROSJEKTANSVARLIG

Det er obligatorisk for studenter å dele meldeskjemaet med prosjektansvarlig (veileder). Det gjøres ved å trykke på "Del prosjekt" i meldeskjemaet. Om prosjektansvarlig ikke svarer på invitasjonen innen en uke må han/hun inviteres på nytt.

TYPE OPPLYSNINGER OG VARIGHET

Prosjektet vil behandle alminnelige kategorier av personopplysninger frem til 3.6.2022.

LOVLIG GRUNNLAG

Prosjektet vil innhente samtykke fra de registrerte til behandlingen av personopplysninger. Vår vurdering er at prosjektet legger opp til et samtykke i samsvar med kravene i art. 4 og 7, ved at det er en frivillig, spesifikk, informert og utvetydig bekreftelse som kan dokumenteres, og som den registrerte kan trekke tilbake. Lovlig grunnlag for behandlingen vil dermed være den registrertes samtykke, jf. personvernforordningen art. 6 nr. 1 bokstav a.

PERSONVERNPRINSIPPER

NSD vurderer at den planlagte behandlingen av personopplysninger vil følge prinsippene i personvernforordningen om:

lovlighet, rettferdighet og åpenhet (art. 5.1 a), ved at de registrerte får tilfredsstillende informasjon om og samtykker til behandlingen

formålsbegrensning (art. 5.1 b), ved at personopplysninger samles inn for spesifikke, uttrykkelig angitte og berettigede formål, og ikke viderebehandles til nye uforenlige formål

dataminimering (art. 5.1 c), ved at det kun behandles opplysninger som er adekvate, relevante og nødvendige for formålet med prosjektet

lagringsbegrensning (art. 5.1 e), ved at personopplysningene ikke lagres lengre enn nødvendig for å oppfylle formålet

DE REGISTRERTES RETTIGHETER

NSD vurderer at informasjonen om behandlingen som de registrerte vil motta oppfyller lovens krav til form og innhold, jf. art. 12.1 og art. 13.

Så lenge de registrerte kan identifiseres i datamaterialet vil de ha følgende rettigheter: innsyn (art. 15), retting (art. 16), sletting (art. 17), begrensning (art. 18) og dataportabilitet (art. 20).

Vi minner om at hvis en registrert tar kontakt om sine rettigheter, har behandlingsansvarlig institusjon plikt til å svare innen en måned.

FØLG DIN INSTITUSJONS RETNINGSLINJER

NSD legger til grunn at behandlingen oppfyller kravene i personvernforordningen om riktighet (art. 5.1 d), integritet og konfidensialitet (art. 5.1. f) og sikkerhet (art. 32).

SurveyXact er databehandler i prosjektet. NSD legger til grunn at behandlingen oppfyller kravene til bruk av databehandler, jf. art 28 og 29.

For å forsikre dere om at kravene oppfylles, må dere følge interne retningslinjer og eventuelt rådføre dere med behandlingsansvarlig institusjon.

MELD VESENTLIGE ENDRINGER

Dersom det skjer vesentlige endringer i behandlingen av personopplysninger, kan det være nødvendig å melde dette til NSD ved å oppdatere meldeskjemaet. Før du melder inn en endring, oppfordrer vi deg til å lese om hvilke type endringer det er nødvendig å melde:

<https://www.nsd.no/personverntjenester/fylle-ut-meldeskjema-for-personopplysninger/melde-endring-er-i-meldeskjema> Du må vente på svar fra NSD før endringen gjennomføres.

OPPFØLGING AV PROSJEKTET

NSD vil følge opp ved planlagt avslutning for å avklare om behandlingen av personopplysningene er avsluttet.

Lykke til med prosjektet!